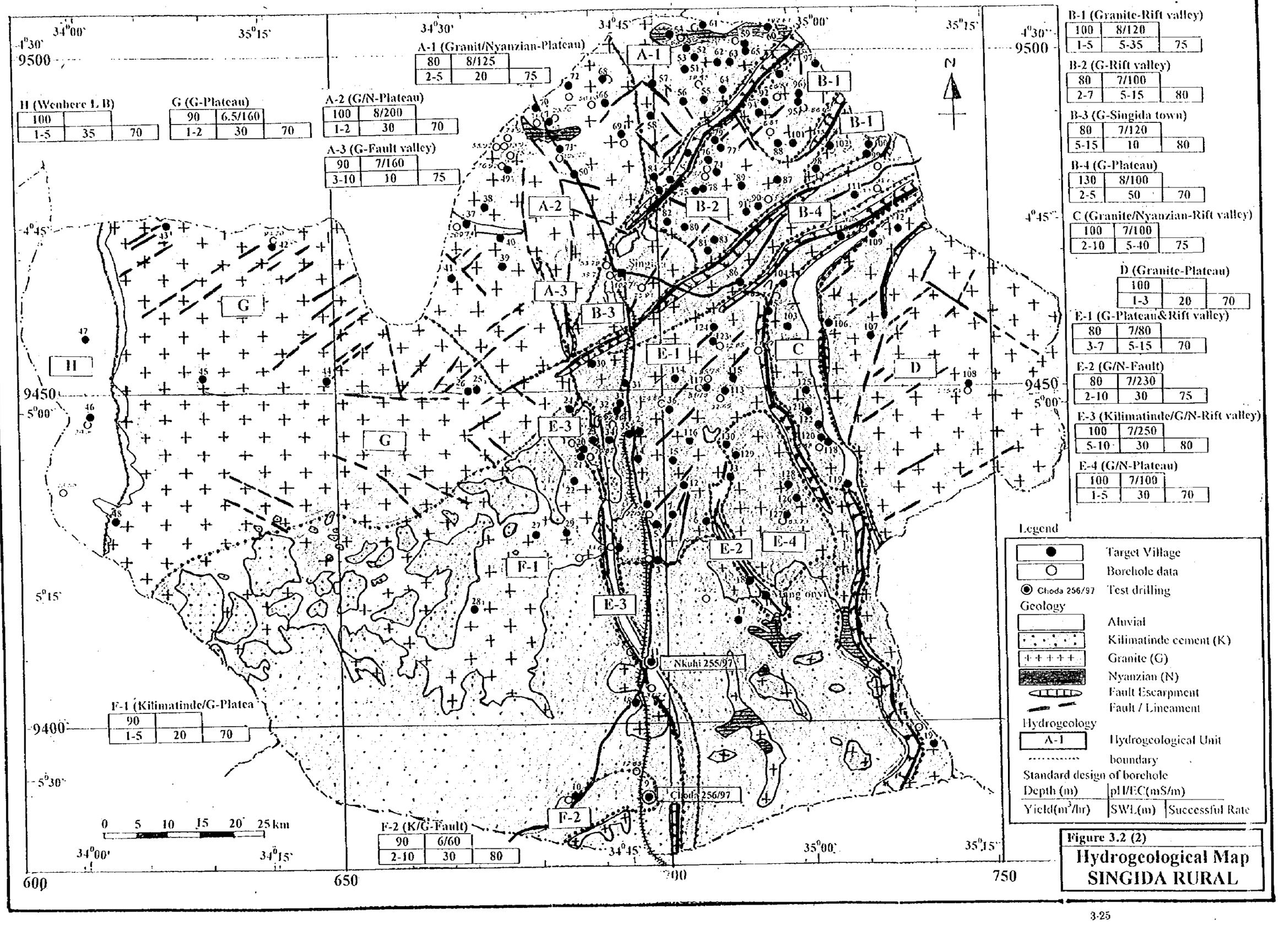


Figure 3.2 (2)

Hydrogeological Map SINGIDA RURAL

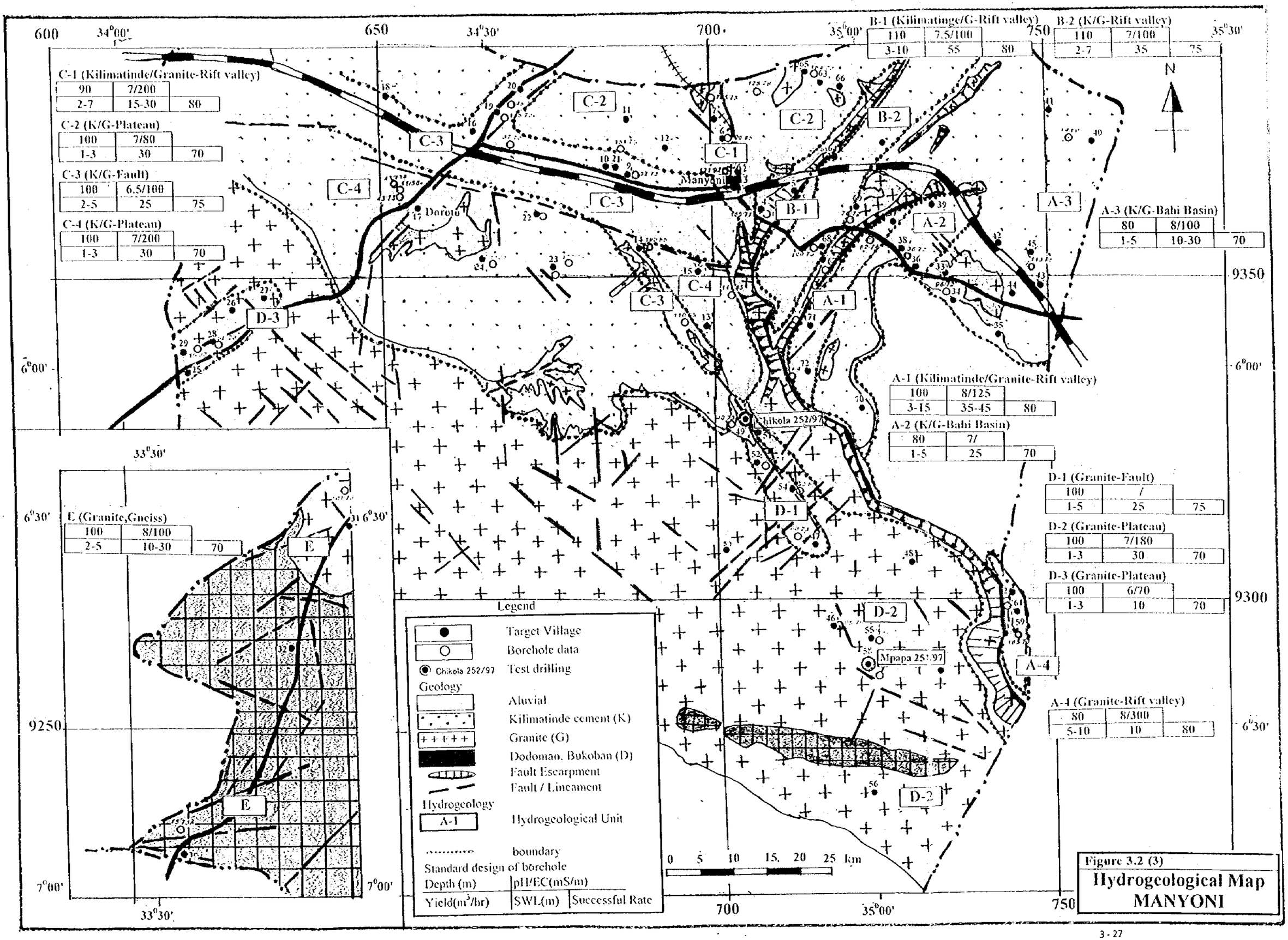


Figure 3.2 (3)
Hydrogeological Map MANYONI

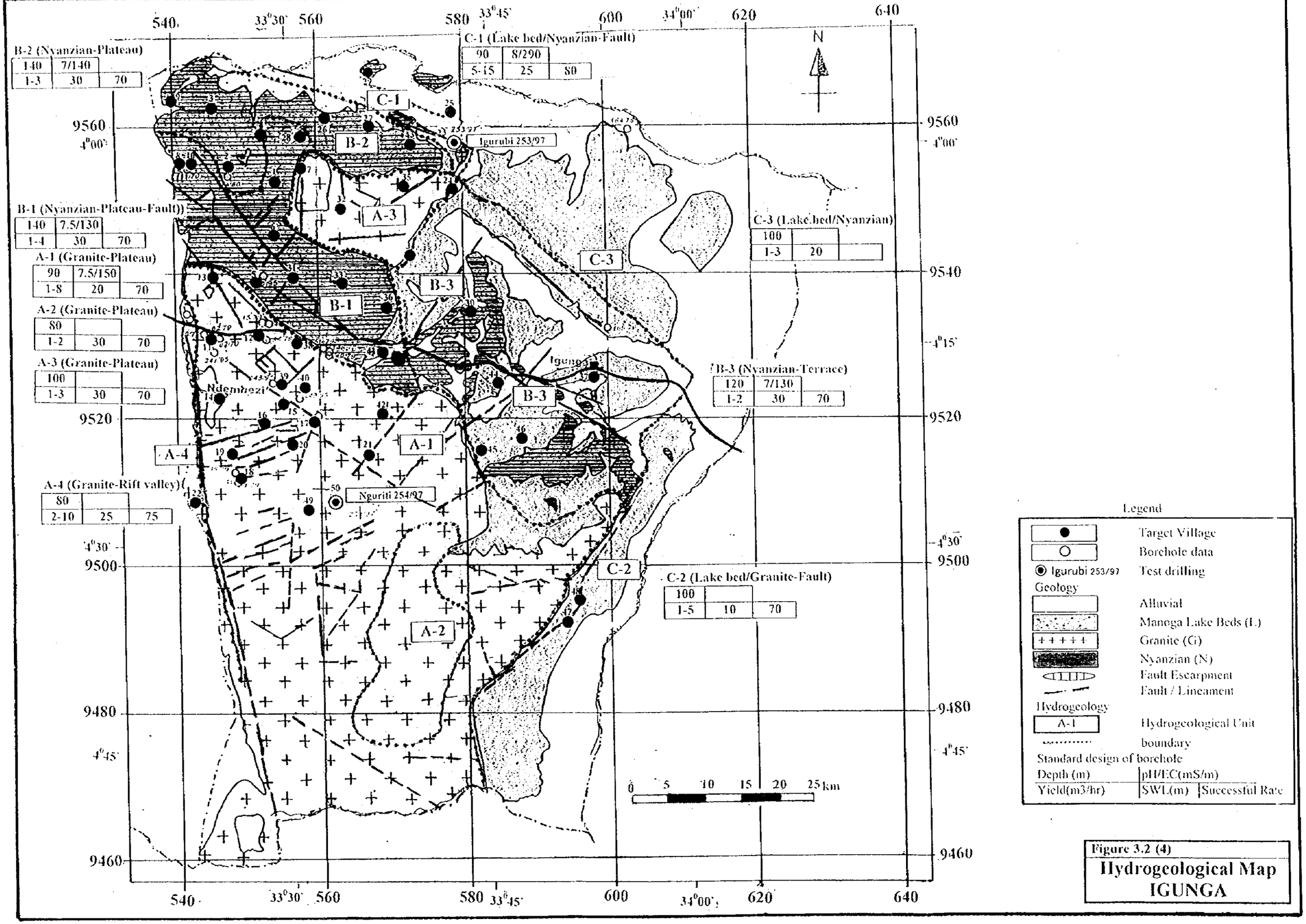
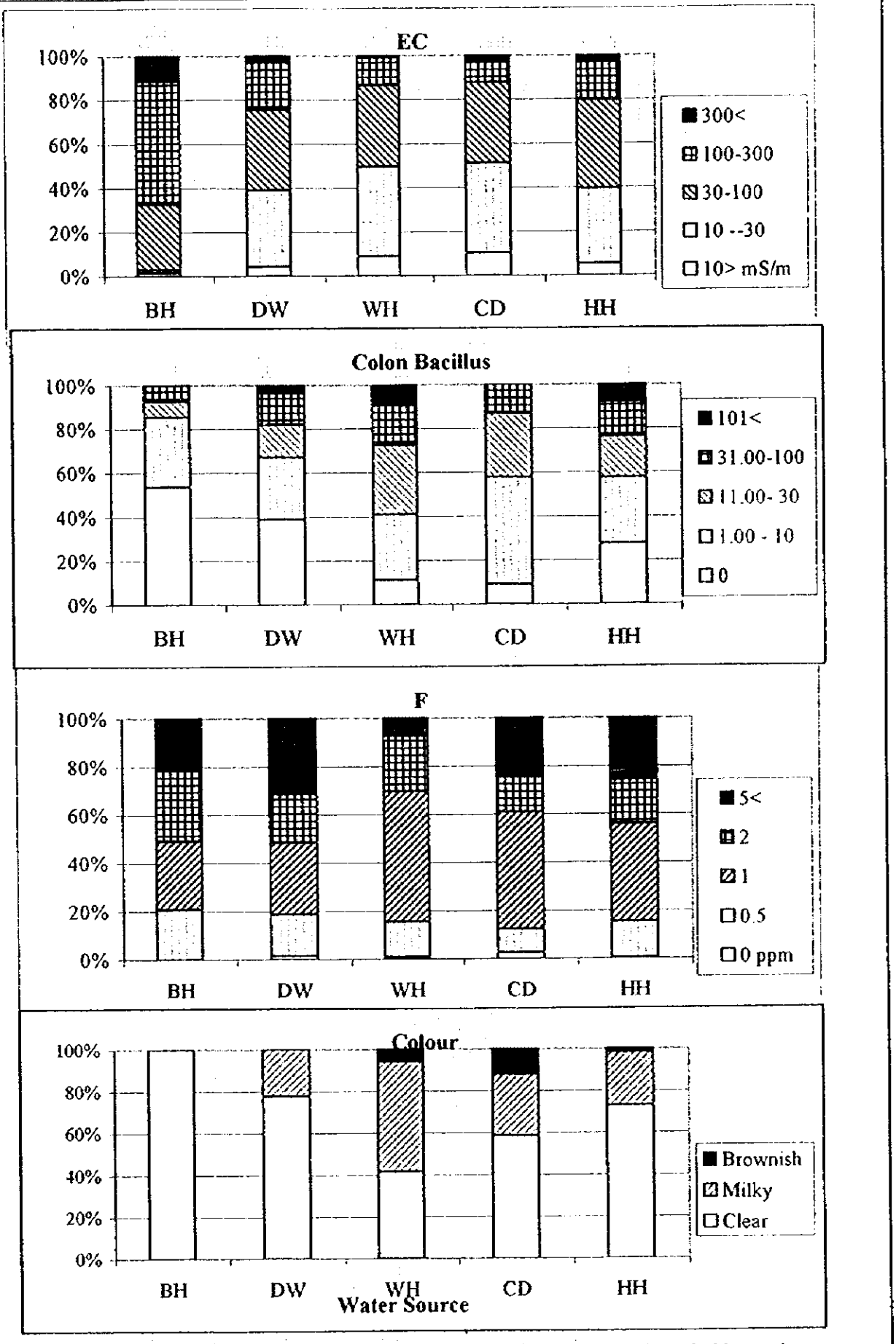


Figure 3.2 (4)

Hydrogeological Map IGUNGA

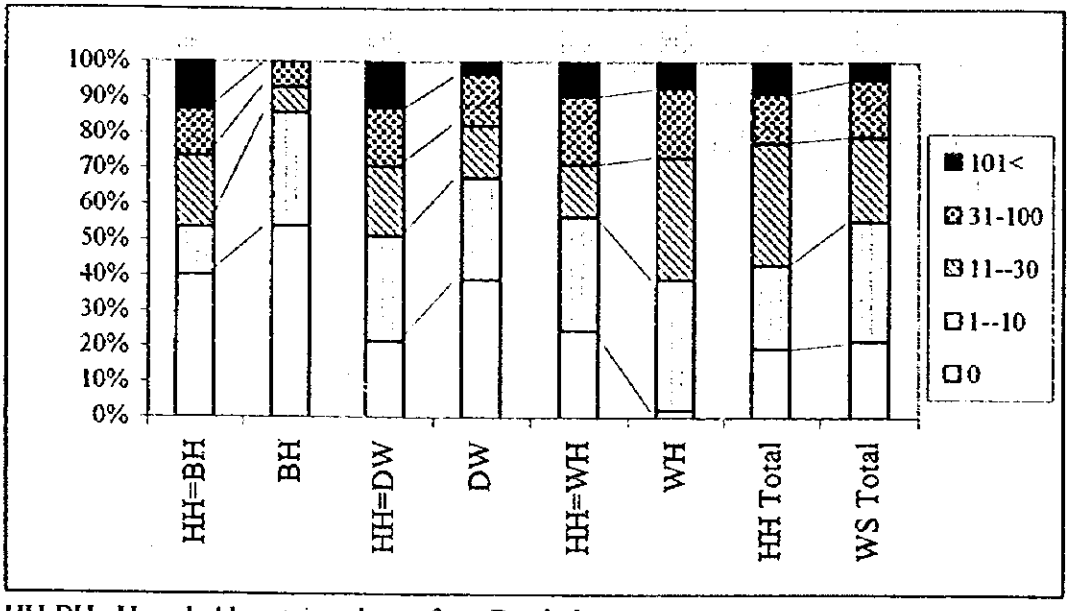
Figure 3.3 Water Quality for Water Sources of Target Villages



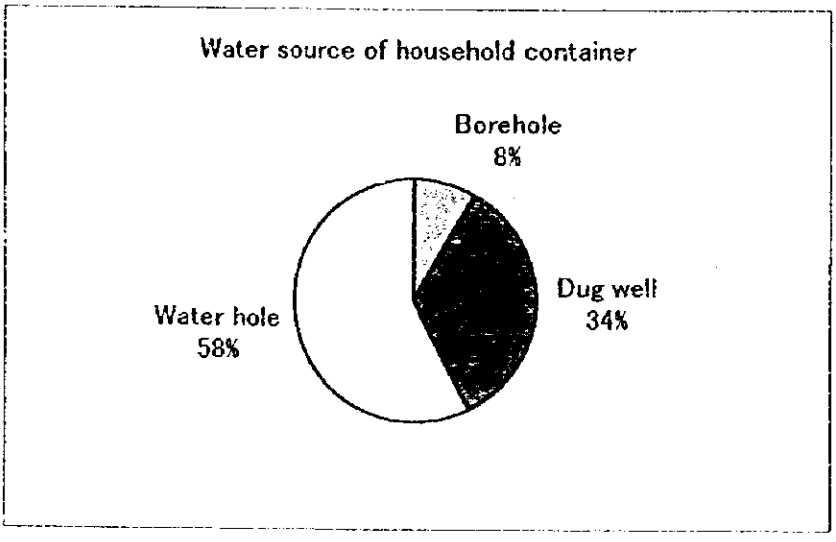
BH=Borehole, DW=Dug well, WH=Water hole, CD=Charco dam, HH=Household container

Table 3.5 Comparison Household & Original source (Colon Bacillus)

		0	1--10	11--30	31-100	101<	Total
Borehole	HH=BH	12	4	6	4	4	30
	BH	37	22	5	5	0	69
Dug well	HH=DW	26	36	24	20	16	122
	DW	45	33	17	17	4	116
Water hole	HH=WH	50	66	30	40	20	206
	WH	4	79	73	42	16	214
Total	HH Total	88	106	155	64	40	453
	WS Total	86	134	95	64	20	399



HH-BH : Household container drawn from Borehole
HH-DW : Household container drawn from Dug well
HH-WH : Household container drawn from Water hole and Charco dam



CHAPTER FOUR: TARGET VILLAGES

CHAPTER FOUR: TARGET VILLAGES

4.1 Institutional and Legislative Setups

4.1.1 Administrative Setup in the Study Area

The Study area covers four districts of Hanang, Singida Rural, Manyoni and Igunga. The districts are administratively divided into divisions, wards and villages. The Study area comprises of 19 divisions, 82 wards and 284 villages.

Table 4.1 Administrative Organisation

District	Division	Ward	Village
Hanang	3	17	33
Singida Rural	7	26	129
Manyoni	6	21	72
Igunga	3	18	50
Total	19	82	284

4.1.2 Local Administrative Setup

(1) District

A district is governed by the District Council which is directly under the Prime Minister's Office (Local Governments and Regional Authorities). The District Council is the highest authority under the Local Government Act 7 (District Authorities) of 1982. In accordance with the provisions of Act 9 of 1982, districts are required to provide financial support to the village councils and township authorities established within the area of its jurisdiction.

The functional departments are involved in the execution of the district programmes under the responsibility of the District Executive Director. Different central government ministers execute programmes in the districts. These include: agriculture, trade, commerce, industry, health, education, relief of poverty, assistance and amelioration of life for the young, aged and disabled, and the development of productive forces to combat poverty, diseases and ignorance.

The District Water Engineer is directly responsible for the execution of the District Council's water projects to ensure effective management of planning, design, rehabilitation, construction, and operation and maintenance of the water facilities in the villages.

(2) Division

The division physically makes up the area of a district council; however, regional administration administers this unit. Historically, when the Africa Chiefs Ordinance was

replaced in 1963 and the position of the chief was relinquished, the title of the chiefdom was replaced by that of a division.

(3) Ward

The ward physically makes up a division; however, administratively they are under the district council. In the Local Government Act No. 7 and 8, provisions are made for the establishment of a ward committee in each ward to be responsible for the implementation of decisions and policies of the district council, and of development schemes which relate to the ward.

(4) Village

A ward consists of several villages. The village government is the smallest local government unit on mainland Tanzania. A village basically must have 250 households or more. The main organs of the village government are the Village Assembly and the Village Council. The former is composed of all the adult members of the village, while the latter is composed of 25 representatives. The Village Council is the executive arm of the village assembly, and has been delegated with the powers to oversee the day-to-day activities in the village, and to make decisions on matters concerning the village on behalf of the village assembly.

4.2 Existing Water Supply Projects

4.2.1 Water Master Plan of Arusha Region

(1) Implementing Period and Donor Agency

The water master plan of Arusha region was formulated in cooperation with UNDP and UNDESD. An interim report was published in July 1993.

(2) Background

Major problems in water supply in Hanang district are related to inadequate sources of water and malfunctioning of the existing schemes. Only 42% of the villages in the District have reliable sources of water, while 45% of the existing water supply schemes are out of operation. In all 40 villages of Hanang district traditional water sources are still considered to be an important element of the water supply.

(3) Objectives

The plan intends to promote water resources development in the rural areas under an investment from national and external sources. The approach set forth in five main elements: (i) inventory studies of existing data, (ii) field survey and identification of potential sources of supply and assessment of demand, (iii) resources evaluation of potential sources, (iv) costing of alternative options, and (v) preliminary design of proposed schemes.

(4) Conclusion

In elaborating proposals for new water supply schemes of villages in Hanang district, four (4) different categories of schemes are considered in the Water Master Plan as follows:

- single piped water supply schemes for six(6) villages,
- grouped piped water supply schemes for two(2) new gravity schemes,
- augmented piped water supply schemes incorporated in existing water supply schemes for four(4) new grouped schemes; and
- point source (borehole or shallow well) water supply schemes in 29 boreholes and 105 shallow wells.

The plan aimed to provide by the year 2012, water schemes to cover about 76% of total population in Hanang district. 24% of population will have to be depended upon traditional sources. The proposed strategy for the O&M of water supply scheme is based on the user's participation.

4.2.2 Water Master Plan of Tabora Region

(1) Implementing Period and Donor Agency

The water master plan of Tabora region was made in 1979 under the funding by the World Bank.

(2) Background

Tabora region is a semi-arid area with a rural population unequally distributed spatially and heavily involved in grazing of livestock. There are many areas where water stress is acute in the dry season. The national goal in water sector was to obtain a water source within five(5) km of every rural household by 1980 and to install distribution systems to bring clean, piped water to 400 m maximum from every household by 1991.

(3) Objectives

The approach emphasises on four (4) items as follows:

(a) scientific assessment of water resources combining spatial data, climatological data and sound analytical formulations;

(b) a spatially desegregated approach that develops the data over the earth and permits aggregation into water resource estimates for villages or groups of villages;

(c) an emphasis on finding the least cost solution to provision of rural water supplies with a specified reliability level; and

(d) planning for water supply development based on the existing situation and balanced improvement of all aspects of provision of rural water supplies.

The objectives of the master plan are to (i) estimate the groundwater (deep) potential over the region, (ii) estimate the shallow well potential over the region, (iii) estimate the surface water potential (for small dams), (iv) estimate the surface water potential (for large dams), (v) estimate water demand for the villages, (vi) analyse hydrology in the region, (vii) carry out a program to estimate water quality and identify water quality problems, (viii) survey and analyse existing water schemes and sources, and (ix) prepare engineering recommendations for construction of rural water supplies in the region.

(4) Priority Villages

Analysis for 23 priority villages with recommendation was done in the master plan. It was expected that those villages should get the first call on the development resources in order of priority. In these 23 priority villages, four (4) villages i.e. Itunduru, Bukoko, Mondo, and Sungwizi villages are nominated as the target villages of the present Study.

(5) Conclusion

The investigation was highly interrelated and comprised three main streams in the water demand studies, the engineering cost studies and the water resource studies. Main conclusions were made to the aspects in remote sensing, hydrology, water quality, hydrogeology, shallow wells, scheme survey, reservoir and charco survey, operation and maintenance, and village data. Conclusions on policies for the water development in the region were made to the aspects in the organisation of RWE's operation, training, and village participation; program for village participation; planning of the water program; livestock watering; design considerations; and water development strategy. Alternative water development strategies were suggested with emphases on development of shallow well, reorganisation of O&M structure and preparation of accelerated program.

(6) Evaluation

As almost twenty years has passed after completion of the master plan, the evaluation of basic planning parameters is necessary as described in the Water Policy that every water master plan is to be reviewed at a 10 year cycle. In this master plan, 23 priority villages were selected, of which four (4) villages are included in the target villages of the present Study.

4.2.3 Activities of NGOs

(1) TCRS (Tanganyika Christian Refugee Service)

In 1984 TCRS undertook a follow-up of the groundwater development program conducted by AIDAB (Australian International Development Assistance Bureau). The project, titled as Singida Integrated Rural Development Project, was implemented until 1995 with three (3) phases programs. The project covered not only the water development aspect but also the

development of environmental sanitation, agriculture and rural community. The outcomes of water development are as follows (1984 to September 1997):

District	S/Well	M B/Hole	Reha./Well	Total
Singida R.	259	61	178	419
Iramba	85	91	56	204
Manyoni	30	32	7	68
Total	374	184	241	691

Notes: S/Well; Shallow well, M B/hole; Medium depth borehole

The phase four program is planned to be implemented for a period from 1996 to 1999 to provide rehabilitation of 70 dug-wells (inclusive of 40 wells by the districts) and new construction of 95 dug wells and 65 medium boreholes.

(2) CPPS (Congregation of Precious Blood Fathers)

CPPS, a Canadian group of NGOs, started its activities under the title of rural water supply project in Manyoni district. The objectives of the project was to construct boreholes equipped with windmill to supply water to the village people. About 60 facilities were constructed so far. It is said that further construction of such facilities will be expanded to other area including Singida Rural district.

(3) CARITAS ARCHDIOCESE

CARITAS Archdiocese is implementing the Igunga water supply programme with a three year construction period of 1997/98 - 2000/01 covering water supply and sanitation activities over 23 villages in Igunga district.

(4) CBCH

CBCH conducts a study on the water supply programme covering eight villages in Igunga district. Out of villages, three villages of Nyandekwa, Ziba and Ndembezi are included in the present JICA Study.

(5) CDTF (Community Development Trust Fund)

CDTF is implementing a project titled Nangwa gravity water supply system. It constructed so far a pipe system from the Nangwa spring to Nangwa, Wareta and Dirma villages inclusive of pipeline of 22 km; five break-pressure tanks; two cattle troughs; two storage tanks and four public domestic points. An expansion of project to Nangwa and Measkron villages is undergoing; and the construction of a new intake, a storage tank and distribution pipes from new storage tank to Measkron village were completed.

(6) ADRA (Adventist Relief Agency)

ADRA implemented the construction of dug-wells of Kangaroo type mainly in Hanang district.

4.3 Inventories of Target Villages

With the purpose of collecting and analysing data and information which are deemed necessary for planning of rural water supply schemes, designing of water supply facilities and management of rural water supply projects, the village inventory surveys were conducted in the phase 2 study period covering the 284 target villages. The village inventory surveys consist of target village survey, sample household survey, hydrogeological survey, water quality survey, geophysical survey and inventory of existing water supply facilities.

In this section the salient outcomes of the target village survey and sample household survey are herein presented, whereas the results of other fields are given in the respective chapters.

4.3.1 Methodology

The Study team organised several survey teams so as to conduct the survey of the 284 target villages and 4,489 sample household survey within the given time schedule. The survey items for the village survey included general profiles of villages, village administrative setup, economic activities, gender division of labour, current water supplies, public health and health education and others. And for the sample household survey, it covered household information, current water supply, water supply required, health and sanitation, gender issues and willingness to pay for water.

(1) Motivation of Villagers

Prior to the commencement of the inventory survey, motivation of villagers for the village survey and sample household survey was carried out by the District Water Engineers concerned and the Study team. The attendants included the village executive officers, the chairperson or secretary of the village water committee, teachers of the primary school, the chairpersons or secretaries of parents, women and youth organisations.

(2) Village Survey

In most villages, attendants were the village chairpersons, the members of village councils, the members of village water committees, the village government officers, the teachers of primary schools, staff of dispensaries and the leaders of voluntary groups including women's organisations; in several villages, participants included the council members of districts, divisions and wards, health care assistants and extension workers for agriculture and livestock.

(3) Sample Household Survey

The village convened a general meeting specifically for this exercise. On arrival at each village, the survey team comprising of the supervisor and assistant surveyors attended the village meeting, and then the chairperson invited the supervisor to explain the purpose of the sample household survey. The supervisor divided the villagers presented at the meeting into four groups, i.e. males aged 30 and above, females aged 30 and above, female youths aged below 20 and male youths of the same age. After conducting that exercise, the supervisor and assistant surveyors used the cluster sampling technique to determine the final samples for the whole villages to be interviewed.

4.3.2 Village Inventory Survey

(1) Population

The total numbers of population of the 284 target villages was 692,538 as of 1996 according to the data provided by the district offices concerned. The population of the villages ranges from 410 persons at Kitanula village, Manyoni district to 8,258 persons at Itigi village, Manyoni district with the average of 2,439 persons per village.

Table 4.2 Population in 1996

District	Villages	Sub-villages	Population
Hanang	33	143	62,691
Singida Rural	129	729	339,791
Manyoni	72	287	147,358
Igunga	50	278	142,698
Total	284	1,437	692,538

(2) Village Water Committees and Village Water Funds

The village survey has revealed that out of the 284 target villages 278 villages have organised a Village Water Committee (VWC) and similarly 241 villages have established a Village Water Fund (VWF). The villages which do not have a VWC are those four villages in Singida Rural district and two villages in Igunga district; and those which do not have a VWF amount to 43 villages including two villages in Hanang district, eight villages in Singida Rural district, 10 villages in Manyoni district and 23 villages in Igunga district.

The total numbers of committee members of VWCs are 1,834 persons with an average of 6.6 persons per VWC; however, 49 VWCs have committee members of less than six persons. The seats of women members are less than half of the VWC members in 102 villages; eight villages in Hanang district, 66 villages in Singida Rural district, 14 villages in Manyoni district and 14 villages in Igunga district.

The total VWFs raised for village water supplies amount to Tsh 31,732 thousand, or equivalent to Tsh 132,000 per VWF ranging from Tsh 3,000 to Tsh 1,685 thousand.

(3) Public Health

There are 191 of health facilities including hospitals, health centres, mother and child health clinics (MCHCs) and dispensaries as given below:

Table 4.3 Health Facilities

Facilities	Hanang	Singida (R)	Manyoni	Igunga	Total
Hospital	-	1	5	2	8
Health Centre	-	11	5	1	17
MCHC	6	39	28	13	86
Dispensary	5	37	27	11	80
Total	11	88	65	27	191

(4) Village Health Committees

238 villages have organised a Village Health Committee (VHC). Activities of VHCs include:

- to oversee health activities in their respective villages.
- to ensure environmental sanitation.
- to ensure that underfives are weighed and vaccinated monthly for BCG, DPT, polio, measles and tetanus; and that expectant mothers and all child bearing-mothers are given the tetanus vaccine.
- to sensitise parents to fight malnutrition of their children.
- to serve as liaison between health workers and community members.
- to assist to sensitise the villagers on human cleanliness and water and environmental sanitation.
- to ensure that all people have pit-latrines in the villages and make use of them effectively.
- to sensitise community on vaccinations, environmental sanitation, building spacious houses with ventilation, using pit-latrines and drinking safe and clean water.

(5) Vaccination Campaigns

Vaccination campaigns were carried out in 150 villages with health facilities mentioned above including two villages in Hanang district, 121 villages in Singida Rural district, 17 villages in Manyoni district and 10 villages in Igunga district. The vaccinations for the

underfives are BCG and TB; and others are polio, measles, DPT and tetanus. Also, the tetanus vaccine is given to expectant mothers who visit the clinic.

(6) Hygiene Education

There are 257 primary schools with a total enrolment of about 103,000 pupils. Hygiene education is not taught as an independent subject in the primary schools in the Study area. The elements of hygiene education are taught under the health subject for Standards I~II and under domestic science and science (nutrition) subject for Standards III~VII in most of the primary schools.

Teaching is done by applying theory in classes and by making demonstrations during practical presentations. Due to shortage of demonstration materials, greater emphasis is placed on classroom teaching. At some primary schools, the pupils are taught when they visit the dispensary.

4.3.3 Sample Household Survey

A total of 4,489 respondents were interviewed using questionnaires: 540 samples in Hanang district, 2,119 samples in Singida Rural district, 940 samples in Manyoni district and 890 samples in Igunga district.

(1) Current Water Supply

The results of survey centring on water fetching and per capita water consumption are given as follows:

The average distance from the houses to the water sources is the longest in Hanang district with 4.3 km, being followed by 3.8 km in Igunga district, 2.9 km in Singida Rural district and 2.4 km in Manyoni district.

The average time taken for water fetching at a time is the longest in Hanang district with 2.8 hours, being followed by 2.0 hours in Igunga district, 1.7 hours in Singida Rural district and 1.4 hours in Manyoni district. The average number of persons per household who join in water fetching at a time is the largest in Manyoni district with 2.5 persons, being followed by 2.4 persons in Singida Rural district, 2.3 persons in Hanang district and 2.2 persons in Igunga district. There is a tendency that the longer the distance is, the fewer the number of persons to fetch water becomes; however, there is not much difference in the number of persons to fetch water among the districts.

The average frequency of water fetching per day is the highest in Manyoni district and Igunga district with 2.5 times, being followed by 2.4 times in Singida Rural district and 2.1 times in Hanang district. The average volume of water fetched a day per household is the greatest in Igunga district with 4.2 bucketful (84.0 lit), being followed by 4.1 bucketful (82.0 lit)

in Singida Rural and Manyoni districts and 4.0 bucketful (80.0 lit) in Hanang district. There is not much different in the average volume of water fetched among the districts.

Per capita per day water consumption is obtained by dividing the above-mentioned volume of water by the average household sizes of 5.9 persons in Igunga district, 5.8 persons in Singida Rural district, 5.7 persons in Manyoni district and 5.6 persons in Hanang district. The water consumption rates in terms of litre per capita per day (lcd) are 14.5 lcd in Manyoni district, 14.3 lcd in Hanang district and 14.1 lcd in Singida Rural and Igunga districts. The situation of current water supplies in the Study area is given as the weighted average of the four districts as follows:

- Distance to water sources	:	3.1 km
- Time for water collection	:	1.8 hours
- Number of persons for water collection:		2.4 persons
- Daily frequency	:	2.4 times
- Total hours spent for water collection	:	10.4 hours/day/household
- Volume of water collected per day	:	4.1 bucketful
- Water consumption rate	:	12.0 lcd

(2) Willingness to Pay for Water

The interviewees have responded to the question "How much will you pay for water if water for domestic use with good quality is provided throughout the year?". The average value of willingness to pay for water in terms of Tsh per bucketful is the highest in Singida Rural district with Tsh 96.4 (Tsh 4.8/lit), being followed by Tsh 72.7 (Tsh 3.6/lit) in Hanang district, Tsh 71.9 (Tsh 3.6/lit) in Manyoni district and Tsh 61.1 (Tsh 3.1/lit) in Igunga district. The weighted average is Tsh 81.5 (Tsh 4.1/lit) for the whole Study area.

(3) Common Diseases

The common diseases in the Study area are presented in their degree of severity from above: malaria, diarrhoea, typhoid, skin disease, worms infestation, dysentery, amoebiasis, cholera, bilharza and hepatitis. The incidences of the top five diseases are 81% for malaria, 56% for diarrhoea, 45% for typhoid, 31% for skin diseases and 30% for worms infestation. The above-mentioned diseases are in one way or another connected with water provision; and such there is a need to intensify community efforts to sensitise villagers about the need to use clean and safe water.

An annual medical expenditure is Tsh 23,000 or US$ 37 per household on an average.

4.3.4 Household Economy

(1) Economic Activity

General information on household economy is obtained from the results of sample household survey covering 4,489 samples. The Study team conducted surveys of 84 households in the pilot villages by means of interviews with villagers in order to supplement the results of the sample household survey. Detailed statistical data on villagers' economy were available with the district offices.

In the Study area, households usually engage in two or more kinds of economic activities. Questions about their annual income by sources were put to villagers allowing multiple answers. The surveys show that a majority of households engage in livestock raising and commerce along with growing of crops. Major commercial activities of villagers include the making and selling of local brews, bakeries and handicrafts, grain milling and oil processing. The percentage of households by their economic activities are given below:

Economic Activity	Percentage of Households
Growing of Crops	100
Livestock Raising	78
Commerce	33
Others	11

(2) Annual Household Income

According to the above-mentioned surveys, the average annual household income worked out to Tsh 410,276 ($ 449), or equivalent to 83% of the national average annual household income in rural area of Tsh 494,448 ($ 791) in 1996. In the calculation, home consumption is included as the amount of agricultural products consumed by the households is theoretically a part of household income.

Table 4.4 Average Annual Household Income

Income Sources	Annual Income (Tsh)	Percentage
Selling of Crops	115,105	28.0
Selling of Livestock	71,274	17.4
Commerce	49,264	12.0
Wages and others	44,629	10.9
Home consumption	130,004	31.7
Total	410,276	100.0

The average annual household income on the district basis is Tsh 531,786 in Igunga district, Tsh 423,945 in Singida Rural district, Tsh 317,752 in Hanang district and Tsh 315,815 in Manyoni district with the weighted average of Tsh 410,276 for the whole Study area as explained above.

The median of the household income is Tsh 245,000; namely, the annual income of the 50% households is lower or higher than Tsh 245,000. Annual income of 77% of the total households is lower than the average annual income of Tsh 410,276. The households are classified into five equal number of household groups regarding their annual income, namely lowest 20% group, second 20% group, third 20% group, fourth 20% group and upper 20% group. The average annual income of the groups is as follows:

Income Group	Average Annual Income
Lowest 20%	Tsh 145,000
Second 20%	Tsh 215,000
Third 20%	Tsh 280,000
Fourth 20%	Tsh 460,000
Upper 20%	Tsh 1,000,000

4.3.5 Gender Issues and WID

(1) Situation of Women

In the Study area, women have to take responsibilities for most of work in agriculture and for all household activities. Despite women's heavy responsibilities, their participation in decision making at all levels is still very limited.

The main occupation of the people in the Study area is agriculture, both crop production and livestock rearing. Taking the Hadzabe for instance, who depend on solely on hunting and gathering, men do the former, the gathering is shared. The Barbaig on the other hand, who also depend solely on livestock keeping, it is women who construct the temporary huts, look after cattle/calves, do milking and look after children while men are responsible for increasing the herd. For the rest of tribes residing in the Study area, the case is different. Being mostly farmers, the division of labour between men and women is quite unequal.

Overall picture connotes the facts that women in most of the villages have been deprived of their basic human rights. The majority of women are poor, who are being exploited as agricultural producers involved in food and cash crop production. Women do all household activities, and they do not have any access and control over resources. They are not even involved fully in decision making structures at different levels of the society.

(2) Daily Activities

In the Study area, it is women who provide welfare needs to their families, on top of which they have responsibilities for the care, informal education and up-bringing of children. The daily activities carried out by women are much more similar from one village to another. Most of women interviewed have argued that they work for almost 15 to 16 hours every day. The daily activities done by most women, among others, include fetching of water for domestic use.

According to the results of the sample household survey, about 50% of households could not differentiate the roles performed within the households; however, the fact remains that women have the overall responsibilities of collecting water for home use. Taking Singida Rural district as an example, of those 772 households that were able to differentiate the roles within the household, 685 households (or, 76%) argued that water fetching for domestic use is the responsibilities of women.

In addition to water collection, daily activities by women include cleanliness of the home and its environment, cooking of food for family, washing of clothes, dishes and others, care of children, collection of cow dung, processing of milk products and selling of milk, and looking after calves.

The gender division of labour in most of the villages overloads women with many activities as compared to men, denying women's time for leisure at all, as enjoyed by men. According to the village inventory survey, the major activities done by men in all districts are farming and livestock grazing.

(3) Women in Agriculture

Women in the Study area, as it is the case in many parts of the country, are the main producers of agricultural products. There are agricultural roles which are specific to each sex and those which are shared. Agricultural roles specific to women are farm preparation, cutting of crop remnants, sowing, spreading of farmyard manure in the farms, looking after birds, separation of the produce and husks, transportation, storing and preservation of the produce. The shared ones are cultivating, weeding, harvesting and threshing.

Most of women in the Study area are smallholder agricultural producers and face additional constraints which men do not. These constraints include: limited assistance from their husbands, time constraints because of heavy demands of house work and child care, limited access to extension advice for raising yields, limited money to invest in improved inputs due to lack of access to credit, greater demands on cash for household expenses, and fewer opportunities and less time for other income generating activities.

(4) Income Generating Activities

In the Study area, the sample household survey revealed that a very small portion of women are members of women groups: 10.4% in Manyoni district, 17.6% in Hanang district and 25.7% in Singida Rural district. Most of women are not aware of the idea of forming or joining women organisations and/or groups: 68.3% in Manyoni district, 73.7% in Hanang district and 60.2% in Singida Rural district. Very few women had not joined women groups because of their husband refusal to give permission: 0.1% in Manyoni district, 1.7% in Hanang district and 0.2% in Singida Rural district.

The majority of women interviewed indicated that among the major constraints they face as regards their income generating activities include lack of capital; lack of raw materials; lack of market information; and lack of the necessary skills to effectively run their projects. The sample household survey, however, showed that most of women interviewed are not aware of any training programmes to be provided to women groups on how to run income generating activities: 67.7% in Manyoni district, 70.1% in Hanang district and 59.8% in Singida Rural district.

(5) Access and Control over Resources

Women in all villages do not have access and control over available resources. As a result, women can not carry out production activities effectively. Land, for example, which is a major and most valuable resource in the rural areas, is being owned by men. The responses to the question that who control the income from sales of farm products between men and women or both gave the highest score of 43.6% (both) in Singida Rural district, 55.5% (both) in Manyoni district and 48.9% (both) in Hanang district according to the results of the sample household survey. The basic fact, however, is that when farm products are sold, it is men who have control over cash money obtained. In pastorals communities, it is men who have control and the say on the animals, including decision on when and how many to be sold. Women are not involved in such decision at all.

(6) Participation in Decision Making Structure

Women in the Study area are not equally represented like men in the decision making structures at different levels. As a result, women development needs are not fully addressed when various decisions are being made. The sample household survey revealed that very few women have ever participated in village meetings: 33.6% in Manyoni district, 33.0% in Singida Rural district and 25.8% in Hanang district. Although the Government has issued various policies directives to ensure increased participation of women in decision making, but the number of women involved is still very small.

4.3.6 Village Type

Among many parameters that represent the socio-economic situation of the target villages, four parameters, which can be quantitatively evaluated, have been selected in order to provide the representative indexes of the characteristics of individual target villages. They include: village population, average annual household income, number of livestock and current water service coverage.

(1) Village Population

The village population in 1996 ranges from 8,258 persons at Itigi village in Manyoni district to 410 persons at Kitanula village in Manyoni district with the average of 2,439 persons per village. The village population of 284 target villages was classified into four equal number of village groups, namely A (3,000 persons and over), B (2,200 to 2,999 persons), C (1,600 to 2,199 persons) and D (410 to 1,599 persons) in the order of high to low. The distribution of village population is given below:

Table 4.5 Village Population

District	A	B	C	D	Total
Hanang	5	5	10	13	33
Singida Rural	42	36	32	19	129
Manyoni	7	15	18	32	72
Igunga	17	15	11	7	50
Total	71	71	71	71	284

(2) Annual Household Income

Information on annual income of villagers are gathered through the sample household survey and pilot village survey, based on which the average annual household income is estimated on the village basis. The average annual household income on the district basis is worked out at: Tsh 318,000 for Hanang district, Tsh 424,000 for Singida Rural district, Tsh 316,000 for Manyoni district and Tsh 532,000 for Igunga district.

The annual household income groups are classified into four equal number of village groups, namely A (Tsh 410,000 and over), B (Tsh 308,000 to 409,000), C (Tsh 205,000 to 307,000) and D (less than Tsh 205,000) in the sequence of A to D in the order of high to low income. The distribution of household income groups is as follows:

Table 4.6 Annual Household Income

District	A	B	C	D	Total
Hanang	4	8	12	9	33
Singida Rural	45	36	27	21	129
Manyoni	13	10	15	34	72
Igunga	9	17	17	7	50
Total	71	71	71	71	284

(3) Livestock

Livestock raising is a major economic activity in the Study area. About 80% of households are engaging in livestock keeping and selling of products. The survey of livestock was made through the village inventory survey. The number of cattle, goats and sheep is converted into the livestock units as defined that one livestock unit is equivalent to one head of cattle, or five goats or five sheep. Then the livestock units are divided by the village population to estimate the number of livestock per capita of the village concerned. The livestock unit groups are classified into four equal number of village groups, namely A (1,36 unit and over), B (0.80 to 1.35 unit), C (0.55 to 0.79 unit) and D (less than 0.54 unit) as given below:

Table 4.7 Livestock Unit

District	A	B	C	D	Total
Hanang	17	6	6	4	33
Singida Rural	19	36	37	37	129
Manyoni	26	11	12	23	72
Igunga	9	18	16	7	50
Total	71	71	71	71	284

(4) Current Water Supply

The village inventory survey included data collection and analysis of the situation of current water supplies such as number and types of water sources, types of pumps, delivery systems, causes of interruption of water supplies and so on. Available water sources are boreholes, shallow wells, dams and charco. The water yields of these water sources were estimated to obtain present service populations as presented in 4.4 Inventory of Existing Water Facilities of this chapter.

The service population per village is converted into service coverage in terms of percentage by dividing the number of people served by the total village population. As a result, it is known that service coverage of 54 villages is 100% and 0% for 94 villages. The people of 94

villages are fetching water from dug wells and other temporary water sources. The service coverage groups are classified into four village groups, namely A (100% coverage), B (50% to 99% coverage), C (10% to 49% coverage) and D (0% coverage). Distribution of villages is given below:

Table 4.8 Service Coverage

District	A	B	C	D	Total
Hanang	-	2	2	29	33
Singida Rural	35	28	28	38	129
Manyoni	14	11	20	27	72
Igunga	5	27	18	-	50
Total	54	68	68	94	284

4.4 Inventories of Existing Water Supply Facilities

(1) Inventory Survey

The inventory survey on the existing water facilities over 284 target villages was conducted by the Study Team to obtain basic data and information for the formulation of rehabilitation plan and construction plan of new water facilities.

(2) Existing Water Sources

The inventory of existing facilities by village is concluded in Appendix-3(1)~(4) and summarised in the following Table 4.9.

Table 4.9 Summary of Existing Water Supply Facilities

District	Population	No. of Water Sources in Use									No. of Water Sources not in Use								
	(1997)	BP	BW	WP	WL	WH	DM	SP	OT	Total	BP	BW	WP	WL	WH	DM	SP	OT	Total
Hanang	62,501	1	0	3	0	167	4	3	4	182	1	0	13	0	0	1	0	0	15
Singida R.	339,791	37	4	221	147	246	13	8	4	680	46	2	19	4	1	2	0	0	74
Manyoni	147,358	27	23	45	19	69	5	0	2	190	29	5	0	0	2	0	0	0	36
Igunga	142,698	6	0	5	21	121	44	0	6	203	5	0	1	0	3	1	0	0	10
Total	692,348	71	27	274	187	603	66	11	16	1,255	81	7	33	4	6	4	0	0	135

Notes: BP: Borehole with pump/Engine or Handpump; BW: Borehole with Wind-pump;
WP: Dug-well with Handpump; WL: Dug-well Only; WH: Water-hole;
DM: Dam (inclusive of charco); SP: Spring; OT: Others (Lake, river)

(3) Remarks

The rural population in the target villages depend upon 1,390 water sources in the Study area, of which 135 or 10% sources are out of operation. The water sources include water-holes (609 or 44%), dug-wells (498 or 36%), boreholes (186 or 13%), charcos (70 or 5%) and others such as springs and other sources (27 or 2%).

The water supply coverage by borehole and dug-well systems as of 1997 was estimated as shown in the following table on condition that one handpump system commands 430 service population and L-2 system commands a service population depending on its borehole yield (refer to Appendix-3(1)~(4)).

Table 4.10 Water Supply Coverage

District	Total Population	Service Population	Coverage (%)
Hanang	62,501	4,580	7.3
Singida Rural	339,791	186,492	54.9
Manyoni	147,358	67,838	46.0
Igunga	142,698	15,518	10.9
Total	692,348	274,428	39.6

Following remarks are made based on the previous summary of existing water supply facilities. The table below gives the distribution of boreholes and dug-wells as the main water sources in the Study area. Most of the villages in Singida Rural and Manyoni districts rely their water sources on boreholes and dug wells.

Table 4.11 Distribution of Boreholes and Dug-wells

	Target	Water Source		
District	Villages	Boreholes (%)	Dug wells (%)	Total (%)
Hanang	33	2 (1)	16 (3)	18 (3)
Singida Rural	129	89 (44)	391 (79)	480 (70)
Manyoni	72	84 (48)	64 (13)	148 (21)
Igunga	50	11 (7)	27 (5)	38 (6)
Total	284	186 (100)	498 (100)	684 (100)

With respect to service level of the existing water supply systems, the following classification is made:

Service Level-1 : -Borehole with handpump (BH+HP)
: -Borehole with wind-pump (BH+WM)
Service Level-2 : -Borehole with engine driven pump (BH+EP)

According to the above classification, of 186 water systems that depend on borehole as water source, 71 systems were of Service Level-2.

Table 4.12 Borehole Systems by Service Level

	Level-1		Level-2	
District	BH+HP(%)	BH+WM (%)	BH+EP (%)	Total (%)
Hanang	1	0	1	2 (1)
Singida Rural	38	6	45	89 (48)
Manyoni	35	28	21	84 (45)
Igunga	7	0	4	11 (6)
Total	81 (44)	34 (18)	71 (38)	186 (100)

Though 186 water supply systems with borehole were constructed so far, 88 systems (47%) are out of operation chiefly due to breakdown of engines and pumps as given below:

Table 4.13 Operating Conditions of Borehole System

	Level-1		Level-2	
Particulars	BH+HP	BH+WM	BH+EP	Total (%)
In operation	53	27	18	98 (53)
Out of operation	28	7	53	88 (47)
Total	81	34	71	186 (100)

4.5 Pilot Study

4.5.1 Objectives of the Pilot Study

In accordance with the Minutes of Meetings on the Scope of the Work agreed upon between the Ministry of Water and JICA on November 8, 1996, the pilot study has been implemented with the following objectives:

(i) Geophysical Exploration and Test Drilling:

In order to confirm the groundwater potential, geophysical exploration and test drilling will be conducted at selected two sites in three districts of Singida Rural, Manyoni and Igunga and four sites in Hanang district. As the geological configuration is more complicated in Hanang district compared to other districts, four test drillings will be carried out in Hanang district.

(ii) Production Wells:

If these test wells are proved to yield sufficient amount of water, adequate types of water facilities will be installed to convert them into production wells.

(iii) Rehabilitation Works:

Rehabilitation works of certain water supply facilities at selected sites will be carried out to scrutinise the availability of these types of facilities to the present natural and socio-economic situation of the villages.

(iv) Mobilisation of Villagers:

When sufficient amount of water for installing facilities is assured, mobilisation of beneficiaries be realised through various training for members of village water committees, etc.

4.5.2 Types of Proposed Water Supply Facilities and Service Level

For the purpose of the Study, proposed water sources include boreholes (BH) and dug-wells. Four types of water supply facilities are applied to the pilot projects as agreed upon by the Project Working Committee and the Study team. Outlines of the four types of water supply facilities and their service levels are as follows:

- New construction of Borehole with a handpump : Service Level (L-1)
- New construction of Borehole with an engine-pump and a simple distribution system : Service Level-2 (L-2)
- Rehabilitation of water supply facilities : L-1
- Rehabilitation of water supply facilities : L-2

4.5.3 Pilot Villages

(1) Selection of Pilot Villages

(Preliminary Selection)

General information on the target villages was available from the village reports prepared by the district offices concerned. Among many villages that are confronted by water problems, 29 villages were selected for consideration: 10 villages in Hanang district, six villages in Singida Rural district, six villages in Manyoni district and seven villages in Igunga district. In

the selection, considerations were given to geographical distribution of villages, types of existing water sources and facilities and levels of current water supply services.

(Survey Method)

A survey team was organised for selection of pilot villages among the 29 village above. The survey team was composed of the members of JICA Study team, counterpart personnel and officials from the district offices.

On arrival of the survey team, meetings with leaderships of the village were held for explanation of the purposes of the survey and hearing of general conditions on water problems the villagers are facing. In most villages, the attendants were village chairpersons, members of village councils, village government officers, members of village water committees, teachers of primary schools, staff of dispensaries and leaders of voluntary groups. The survey team used two survey methods, i.e. questionnaires and site observation with the purpose of compiling the socio-economic and technical information.

The questionnaires were administered by experts in the fields of operation and maintenance of water schemes, health and environmental sanitation, gender issues and women in development. The questionnaires focused on village executive officers, chairpersons of women organisations, secretaries of village water committees, representatives of youth groups, headmasters of primary schools, rural medical aids and medical assistants in charge of public dispensaries and health centres.

The site visits and observation guides to the water sources and water facilities were carried out by a group of experts in the fields of groundwater, hydrogeology, water quality and water supply facilities, being accompanied by the members of village water committees and village leaders concerned with rural water supplies. Using check lists, observation was made covering availability of water sources, quality of water, working conditions of engineering structures and causes for failure of water supply facilities and so on.

(Selection of 13 Pilot Villages)

Careful selection of villages where pilot projects are to be implemented has been made. All villages for new construction of water supply facilities should have development potentiality of groundwater within certain distances from their village centres. Another consideration was given to community interest and involvement, an important factor for planning and management of rural water supply projects. Villages should have a functional village water committee capable of dealing with operation and maintenance of project facilities and management of water supply projects including collection of water fee from villagers.

In accordance with the agreements made by between the Project Working Committee and the JICA Study team, following 13 villages have been warranted for the implementation of the pilot study:

Table 4.14 Pilot Villages and Construction Works

District	Village	Population	Types of Works and Service Level
Hanang	Bassodesh	1,992	New construction : BH, L-1
	Ishponga	1,494	New construction : BH, L-1
	Mara	1,976	New construction : BH, L-1
	Maskaroda	2,504	New construction : BH, L-1
Singida Rural	Choda	1,325	New construction : BH, L-1
	Nkuhi	2,199	New construction : BH, L-2
	Mang'onyi	2,102	Rehabilitation : BH, L-2
Manyoni	Doroto	1,410	Rehabilitation : BH, L-2
	Chikola	2,152	New construction : BH, L-2
	Mpapa	1,837	New construction : BH, L-1
Igunga	Ndembezi	5,293	Rehabilitation : DW, L-1
	Igurubi	4,425	New construction : BH, L-2
	Nguriti	4,689	New construction : BH, L-1

Notes: BH; Borehole, DW; Dug-well

4.5.4 Participatory Rural Appraisal

(1) General

In order to inform the villagers of the proposed pilot study and implementation procedures of the study, as well as to elaborate on their responsibilities as regards the pilot study and hence get feedback on their preparedness and willingness actively to participate in the study, Participatory Rural Appraisal (PRA) has been carried out at the 13 pilot villages. PRA is an important exercise within the overall study as it leads, to a great extent, to a "sustainable consumer-driven programme based on self-reliance" rather than on a programme that wholly depends on external assistance.

During PRA the villagers were able to collect data, analyse it, identify their problems and prepare their action plans for resolving the identified problems. The philosophy behind this exercise is action by the end-users. Whatever is to be done, should be thought of and decided upon by the villagers themselves, as the programme/project is theirs. The villagers as end-users are made aware of the fact that they will own the facilities and thus they will take full responsibilities for the management, financing and operation and maintenance of the facilities after completion of water supply facilities.

PRA was conducted by well experienced facilitators who were recruited by the Study team. One district community development officer joined the PRA at the respective district. The overall exercise was supervised by the Study team.

(2) Objective of PRA

PRA at the pilot villages was carried out so as to fulfil the following objectives:

- To create awareness of the villagers regarding the proposed study on groundwater development so as to achieve active community participation in planning, implementation and management of their water projects.
- To create awareness and mobilise the villagers to look at their own resources and development needs, come up with priorities, and prepare their own action plans to tackle these needs.
- To create awareness and mobilise the villagers of the importance of active participation by women just like men in decision-making, planning and implementation of the projects.

(3) Methodology

PRA is a combination of semi-structured tools, techniques and activities, used to create awareness and mobilise the villagers. Different tools and techniques were used as given below:

- Semi-structured interviews to obtain community level information. These interviews included focus group discussions, key informant interviews, household interviews and individual interviews.
- Direct observations mainly used to cross check findings and to generate on-the-spot questions and information.
- Ranking used to help identify the main problems of the villagers, their preferences and ranking criteria.
- Review meetings used by PRA facilitators to sort out all the information collected, and compare notes among themselves to avoid inconsistent information or gaps.

The target groups were the villagers themselves including the members of the village governments, village water committees, village health committees, sub-village leaders, religious institution leaders, individual villagers, groups of women, influent people, youth, and even children.

(4) Overall Findings

By conducting PRA, it has been possible to enlarge the portion of the community involvement in planning of the rural water scheme. PRA has revealed the fact that in all the 13 pilot villages, water is a major problem and it affects the overall socio-economic development of the villagers. Women are the most affected group as far as water problems are concerned as they have overall responsibilities of providing water for domestic use at their houses.

Although the villagers are eager to develop their village water schemes, very few are aware of their responsibilities as regards planning, implementation and management of their own village water projects, hence awareness raising on the importance of community management on

self-help basis is to be emphasised. Effective implementation of rural water supply schemes is very much dependent on good and strong local leadership.

Giving the wideness of most of the villages to be involved, it was assumed that the water facilities would be spread over the villages. For this reason, it is important for effective management of a village water supply scheme to scale down to the lowest level as possible. In organising the beneficiaries, the focus should be on water users' groups probably at a sub-village level.

Most of villagers keep livestock. Almost 90% of the villagers were very much concerned about water for their livestock. During PRA it was evident that the use of household latrines is not a common habit. Most of the villagers do not have and hence do not use latrines. This speeds up the spread of diseases such as diarrhoea, besides polluting the environment.

Gender awareness in all the pilot villages needs to be promoted as it appeared to be lagging behind. Gender awareness could be more related to water and sanitation activities. Women and men can participate, if well educated, in very specific planning and management activities.

4.5.5 Training and Sensitisation of Villagers

(1) Preparation of Education Materials

Regular training and sensitisation of the villagers are prerequisite for successful management of the rural water supply projects on a continuous basis. In order to enable the villagers effectively manage their water schemes and to generate the benefits from improving the quality and quantity of village water supplies, draft training materials were prepared for use at the pilot villages, then training materials have been revised for use at the target villages after consideration of the results of the trials. The training materials contain three major subjects related to rural water supplies: health and environmental sanitation; management of the rural water supply projects; and gender awareness.

(Health and Environmental Sanitation)

The most important benefit is an improvement in public health. The provision of safe water is of prime importance to public health and, in combination with other sanitary measures, is an essential prerequisite to eradicating many endemic diseases. The village leaders and especially the members of village health committees need to be educated on how to prevent the villagers from the spread of contagious diseases including:

- dissemination of proper hygiene knowledge on the linkage between water, environmental sanitation and health; and enhancement of the important role in the empowerment of individual user, household and community for self-reliance in the operation and maintenance of water and sanitary facilities, and

- encouragement of individuals to adopt hygiene sense and habit as well as other measures regards health and nourishment.

(Management of Water Scheme)

Depending on their specific roles and responsibilities, it is of at most importance that the members of village water committees and water users' groups be strengthened through training on:

- awareness of roles and responsibilities,
- communication to village governments and other committees,
- water scheme management including financial aspects,
- operation and maintenance of water supply facilities, and
- team work and participation of the villagers.

(Gender Issues)

Women are the principal beneficiaries of the rural water supply projects. Given the fact that for a quite long time women have not enjoyed equal opportunities like men in life thus resulting in poor status of women, special training for women are important, such as:

- competence building,
- economic empowerment i.e. effective identification, planning and implementation of income generating activities,
- family planning, and
- legal rights.

(2) Outlines of the Programme

(a) Task Forces

Two teams of task forces were organised by the JICA Study team to conduct the training and sensitisation programme at the pilot villages. Each team consisted of three facilitators qualified in the field of health and environmental sanitation; management of the rural water supply projects; and gender issues. The programme was implemented in January, 1998 at nine pilot villages. Out of 13 pilot villages, four pilot villages were excluded from the programme; test boreholes were dry at two villages of Ishponga and Nguriti; and two villages of Ndembezi and Igurubi were not accessible during the survey period due to heavy rainfall and road communication breakdown. District officers concerned were invited to join in the programme.

(b) Objectives

It was expected that by the end of the training session participants will:

- have gained sufficient knowledge, skills and information to improve their effectiveness and efficiency in managing their water project,

- have learned participatory methodologies so as to enable them to increase the participation of their fellow villagers in identification, planning, implementation, monitoring and evaluation of their development projects, including the pilot water project,
- have understood the concept of gender and the relationship of gender and development, and thus being in a position to sensitise other villagers on gender issues.
- have learned better health and sanitation practices to educate their fellow villagers with the aim of raising their health status.

(c) Participants

Participants included the representatives of village governments, members of village water committees, village health committees, water users, women representatives, religion leaders and some ward leaders. The numbers of participants range from 28 persons at Chikola and Mpapa villages to 56 persons at Bassodesh village with the average of 37 persons per village.

(d) Methodology

Participatory methodologies were used in conducting the training programme with a view of enabling the participants to apply their own experiences and knowledge in discussing different subjects presented. Methodologies used included role plays, story-telling, group work and plenary discussions. Application of these participatory training methods proved to be efficient as it creates quick and better understanding of subjects discussed by the participants.

(e) Lesson Learnt

Lessons learnt from the implementation of the programme are as follows:

The importance of being self reliant:

The participants noted that it is important for all villagers to unite in trying to solve their own water problems using their own locally available resources. They must show their own initiatives, before donors come-in to assist their efforts. Donor assistance should be appreciated, but should be seen as a catalyst to the whole process.

Cooperation between different actors:

The participants noted that in order to succeed in any development endeavour cooperation between different actors is imperative i.e. villagers, local governments, district councils, NGOs, religious organisations etc.

Latrines:

- Most of latrines constructed are not permanent.

- A good and permanent latrine can be constructed using simple, locally available resources.
- Poor and outdated traditional beliefs regarding the use of latrines do exist. These need to be abolished immediately.
- Villagers are not well educated on the importance of using latrine.

Factors affecting effective community participation:

- Problems of water, consuming most of villagers' day's time.
- Poor leadership.
- Low level of education of leaders and villagers.
- Most of husbands are denying their wives opportunities to participate in development activities because of outdated customs and beliefs.

Village water fund (VWF)

- Sufficient funds are necessary for management of the pilot water projects.
- Water funds should only be used for water project activities and not for any other use. Stern measures should be taken against person(s) to be involved in misuse of these funds.
- Many villagers have not paid the required water fee over a long period of time as there is no properly established systems of collecting water funds. If followed properly, the amount of money in the VWFs will increase considerably.

Water fees:

The participants noted that villagers do not fear to pay water fees. What is important is to educate them the importance of such funds as regards operation and maintenance of their water projects, and giving them transparent financial reports from time to time.

Gender division of labour:

In all the villages, it was observed that gender division of labour has overburdened women with many jobs.

4.5.6 Monitoring and Evaluation

(1) Monitoring

The monitoring and evaluation of the nine(9) pilot projects were conducted in February and May/June in 1998 by the monitoring teams organised by the Study Team. The intentions of monitoring are to improve the efficiency of the pilot study and to contribute more effectively to formulation of development proposals for the Study through generalising findings from the pilot villages to other target villages.

The team prepared two formats; Form A was administered to the village governments, the VWCs, the village health committees and other organisations concerned; Form B was

administered to the beneficiaries putting questions related to water supply schemes such as health and sanitation, toilets, water usage, water fee, women in development and so on.

On the first day, the meeting was officially opened by the village chairman; and then the team leader described the procedure to be followed by the villagers. After interviews, visits to households and public facilities and group discussions, the villagers were reconvened in a plenary session to receive briefings as regards interviews, visits and group discussion. On the second day, the sessions began to review what had transpired on the previous day. Then participants had another plenary session to discuss and make suggestions for improvement.

(2) First Monitoring

First monitoring was conducted from 3rd to 4th February 1998 to visit eight pilot villages; exception of Dembezi village in Igunga district was due to impassability affected by heavy rainfalls. Since the monitoring was conducted in only 30 days after facility operation, any satisfactory results were available in the management and operation of the water facilities, the set-up and collection of water fees and so forth. All the villagers expressed, however, their satisfaction in quality and quantity of water. The results of the monitoring were summarised as follows:

(Water Right)

Out of seven villages where a borehole was newly constructed. Four villages have been given the water right from the government, and the boreholes have been officially handed over to them.

(Water Users' Group)

Two villages in Manyoni district have organised water users' groups on the sub-village basis as proposed by the Study. As for other seven villages, the matter was being given careful consideration. All villages have had watchmen to patrol the water facilities.

(Water Fee)

All villages have not yet decided any formal water fee. All villages insist to use the existing VWF for any necessary expenditure when it arises. Four villages were examining the water fees. Nkuhi village with L-2 service system expressed to take both of that rate and bucket account.

(3) Second Monitoring

Second monitoring was conducted from 25th May to 8th June 1998, about four months after facility operation, covering nine pilot projects. The results are presented below:

(Water Right)

Of seven villages with new boreholes, three villages including Bassodesh and Masqaroda in Hanang district and Chikola in Manyoni district were not yet given water right; however, it is expected that water right be given to the villages on completion of repairing works of the water facilities.

(Village Water Committee and Village Water Fund)

All village water committees VWCs have the committee member of six or more; six VWCs having six members, one VWC having seven members and one VWC having eight members. Regarding the seats of women in VWCs, women share half in five villages and more than half in four villages (Table 4.15). Three villages of Bassodesh, Choda and Dembezi increased seats for women after the implementation of the pilot project.

(Water Users' Group)

Six villages have organised the water users' groups (WUG) as proposed by the Study; two villages were under procedure to form water users' group; and one village of Dembezi in Igunga district, which is equipped with the existing shallow well and the newly fitted hand pump, was considering whether groups are to be organised or not (Table 4.15). All village except Dembezi village have appointed caretakers of two to three persons including pump operator(s). Dembezi village appointed only one watchman but no pump opelator because the existing shallow well has long been maintained without pump operator.

(Water Fee)

By May 1998, five villages have decided water fees. They include Nukuhi, Doroto, Chikola, Mupapa and Dembezi village. Other four villages were reported to be under consideration. The standard water fees estimated by the Study team was officially presented on June 12, 1998 to the representatives of district offices and pilot villages during the course of the workshop held in Singida. The estimated water fees include depreciation of costs of water facilities except boreholes.

Under the above situation, five villages of Nkuhi, Doroto, Chikola, Mpapa and Ndembeji have fixed their water fees. The water fees of Nkuhi village (L-2 service system), Doroto village (L-2service system) and Ndembeji village (L-1 service system) seem to be reasonable enough to recover the expenditure for O&M of their water facilities. The water fees fixed by two villages of Chikola (L-2 service system) and Mpapa are Tsh 1,000/year/person(able bodied). This is underestimated when compared with the standard water fees estimated by the Study team at Tsh 920/month/household for L-1 service system and Tsh

1,120/month/household for L-2 service system in which a family size is assumed to be 5-8 persons.

(Water Leakage)

Through the monitoring it was reported that water leakage took place at two pilot water facilities located in Bassodesh and Masqaroda villages in Hanang district. Leakage from the hand pump in Bassodesh village is due to miss placement of the sealing rubber whereas leakage through the concrete slab of the borehole in Masqaroda village was caused by rising in groundwater level; the borehole was turned to the artesian well.

The repairing works were completed after several delays on August 5, 1998 in Bassodesh village and on August 7, 1998 in Masqaroda village, for which the district water engineer's office provided engineering services with technicians. It is reported the delays are owing to lack of vehicles as well as impassable road conditions near the villages.

Table 4.15 VWC, VWF and Water Users' Groups

Village	Service Level	VWC Member M/F : Total	VWF (Tsh 1,000)	WUG	No. of Caretakers	Water Fee
Bassodesh	L-1	3/4 : 7	341	Not yet	2	Not yet
Mara	L-1	4/4 : 8	185	Organised	3	Not yet
Masqaroda	L-1	3/3 : 6	230	Organised	2	Not yet
Choda	L-1	3/4 : 7	236	Organised	2	Not yet
Nkuhi	L-2	2/4 : 6	226	Organised	3	Fixed
Doroto	L-2	3/3 : 6	383	Organised	3	Fixed
Chikola	L-2	3/3 : 6	533	Organised	2	Fixed
Mpapa	L-1	3/3 : 6	614	Organised	2	Fixed
Ndembezi	L-1	2/4 : 6	8	Not yet	1	Fixed

CHAPTER FIVE: PROJECT PLAN

CHAPTER FIVE: PROJECT PLAN

5.1 Basic Strategy and Criteria in Planning and Design

5.1.1 Basic Strategy

(1) Simple and Least-cost Technology

The major objective of the project is set forth to provide safe and stable water, easily accessible, in quantities adequate for domestic use of the rural population in the Study area. In accordance with the government's policy, the following basic strategy has been applied to the project planning:

- O&M of any water facilities are to be conducted by the user's participation; and
- simple and least cost technology is to be employed for the selection and design of water facilities.

(2) Some for All Principle

In consideration of the huge size of service population residing in the Study area and possible extent of available resource, the "some for all" principle is proposed to be taken into the basic strategy in the project plan. The principle "some for all, not all for some" aims to realise a certain benefit as soon as possible over the beneficiaries as many as possible within a limited extent of available resource.

5.1.2 Planning Criteria

(1) Target Year

The Ministry of Water set forth a standard that the design period of any water supply project is to be a short-term of five years, mid-term of 10 years and the ultimate period of 20 years (Water Supply Design Manual, 1986). The Study has applied a 20 year design period with the target years of short-term, mid-term and long-term as given below:

Project preparation	: the first year (1997)
Short-term target year	: the fifth year (2001)
Mid-term target year	: the tenth year (2006)
Long-term target year	: the twentieth year (2016)

(2) Water Consumption Rate

(a) Domestic Consumption

The Ministry of Water presents in its water supply design manual the design rate of 25 lcd from the tap in the rural area as a minimum water consumption rate, whereas the Arusha Region Water Master Plan adopted a rate of 30 lcd in the target year in consideration of the current water consumption in the Region.

According to the village inventory survey in the Study area, the current average domestic water consumption on the district basis ranges from 10.3 lcd in Singida Rural district to 14.5 lcd in Manyoni district with an average of 12 lcd, less than the recommended rate by UNICEF of 20 lcd for rural water schemes. The Study proposes the following design domestic water consumption rates:

Short-term target	:	20 lcd
Mid-term target	:	20 lcd
Long-term target	:	30 lcd

(b) Livestock Water

The water consumption of livestock of 25 litre per livestock unit per day as designed by the Ministry of Water is adopted to the Study. One livestock unit is equivalent to one cattle, or two donkeys, or five goats, or five sheep, or 30 poultry/hens/duck/geese.

(3) Population Growth Rate and Projection of Population

The population growth rate in planning is forecasted based on the latest national population census (1988) and other authorised data. The future population of target villages in the target years is worked out by applying the present (1997) population obtained through the village inventory survey by the Study Team and the estimated growth rates as given 5.2.1 of this chapter.

(4) Estimate of Water Demand

The water demand of the target villages in the respective target years is calculated on the basis of projected population and the design water consumption rates. It is assumed that the numbers of livestock in the Study area may not increase in future because of sever conditions prevailing in the Study area such as lack of grass land and water in the dry season; and degradation of soils and land.

(5) Water Source

Groundwater is the most appropriate source for any rural water project in terms of quality and quantity to provide safe and stable water. In the Study, the facilities to extract groundwater is to be boreholes and dug-wells for the domestic use. There is a great water demand for livestock. Livestock keepers contribute to the village water funds in some villages. The Study proposes, therefore, to provide small dams (charcos) as a water source for livestock use.

(6) Level of Service

The following two service levels will be provided in the proposed projects:

Service Level-1 (L-1)

The service level provides a water point (point source) facility such as a dug-well protected by lining with a pump or a borehole with a pump without any water distribution system.

Service Level-2 (L-2)

The service level provides a water source of borehole fitted with an engine-driven pump and a simple distribution system with a few public taps. Both the capital and O&M costs of facilities will rise with the service level. In selection of the service level, several factors are involved; they are village interests, locations of water sources or distance from the village centres, financial affordability of the villagers, types of the existing water facilities and yields of groundwater expected.

(7) Design Coverage in Target Year

In consideration of the project size, the possible extent of available resource and the "some for all" principle, the design water supply coverage over the Study area by target year are proposed as follows:

1997:	40 %
2001:	60 %
2006:	80 %
2016:	100 %.

(8) O&M Plan and User's Participation

Many of the completed rural water supply schemes in the Study area are either operating below their design capacity or not functioning at all. The major reason of the malfunctioning of the completed schemes is lack of periodical and preventive maintenance. The lack of routine maintenance of water supplies, among many, considered to be resulted from:

- inadequate recurrent budget;
- reluctance to contribute or inadequate contribution by the user; and
- irresponsible attitude of communities and governmental organisations in charge.

In view of the said fact, the O&M plan in the project following issues are to be taken into account:

- involvement of communities;
- governmental intervention;
- establishment of water user's group under the village water committee; and
- an appropriate water fees affordable to users.

5.1.3 Design Criteria

The water facilities are to be designed as simple, trouble-free operation, and be capable to be operated and maintained by village technicians. The parts required for the repairing and replacement of equipment are to be readily available from the nearest market.

(1) Pumps

(a) Handpump

In areas where groundwater is readily available at a moderate depth, the provision of a number of boreholes and/or wells fitted with handpumps is the cheapest mean in a safe and stable water supply. A handpump is easily maintained by caretakers to be selected from the water users with minimum skills, a few simple tools and modest training. A handpump of deep-well type may be effective to water depth between 10 to 40 meter below the ground surface.

(b) Engine-driven Pump

The water supply system at the service level-2 requires to lift a large amount of water with an engine-driven or motorised pump. The Study proposes to equip the boreholes with engine-driven pumps as most of the existing boreholes at L-2 level are of this type.

(c) Wind- and Solar-pumps

In the Study area 35 water supply systems are equipped with wind-pumps: seven in Singida Rural district and 28 in Manyoni district. The major problem prevailing in the systems is the fluctuation of the force of the wind, being down towards the early rainy season through the end of the dry season. The water facilities could be operated by a solar-pump system which consists of photovoltaic array and submersible pump. Though the initial cost of system is expensive, the O&M cost is very cheap. A solar-pump system is in operation at St. Gaspar Hospital in Manyoni district. It is obvious that maintenance service systems are not developed yet around the Study area. A careful examination whether or not the system is feasible, is required in view of cost/performance of the system.

(2) Operation Hour of the Water Facilities

In general, operation of eight hours a day is preferable for rural water schemes: four hours in the morning and another four hours in the evening. In view of the "some for all" principle, the operation of 10 hours a day in principle is proposed for the Study.

5.2 Water Source Development Plan

5.2.1 Population Growth Rate and Projection of Service Population

(1) Population Growth Rate

The latest national population census (1988) gives the average annual population growth rates (1978-1998) of four districts in the Study area as follows:

Hanang District	:	4.03 %
Singida Rural District	:	2.92 %
Manyoni District	:	2.85 %
Igunga District	:	0.71 %

The Ministry of Health estimated the national population in 2000, in which the following annual growth rates for the four districts in the Study area were applied (Health Statistics Abstract, 1996):

Hanang District	:	3.36 %
Singida Rural District	:	2.97 %
Manyoni District	:	2.85 %
Igunga District	:	0.71 %

The annual population growth rates projected by the Ministry of Health have been modified by quoting the trend of population growth rates given in the Bureau of Statistics (Statistical Abstract, 1995) in which the annual population growth rates of Tanzania mainland are projected in consideration of social factors as 2.85 % to 1995, 2.85 % to 2000, 2.81 % to 2005 and 2.73 % to 2010. Accordingly, the following annual population growth rates are proposed to estimate the future population in the Study area:

Table 5.1 Annual Population Growth Rate (%)

District	1997 - 2001	2002 - 2006	2007 - 2016
Hanang	3.36	3.32	3.24
Singida Rural	2.97	2.93	2.85
Manyoni	2.85	2.81	2.73
Igunga	0.71	0.71	0.71

(2) Projection of Service Population

In accordance with the annual population growth rates of the districts estimated for the target years (refer to Section 5.1.2), the total population is projected as shown in Table 5.2. The total population in the Study area is projected to increase from 696,311 in 1997 to 1,148,000 in 2016, being about 1.6 times of the current population.

Table 5.2 Projected Population by Target Year and District

District	1997	2001	2006	2016
Hanang	62,501	73,731	86,810	119,412
Singida Rural	343,754	397,926	439,740	608,912
Manyoni	147,358	169,588	194,793	255,003
Igunga	142,698	147,836	153,160	164,386
Total	696,311	789,081	874,503	1,147,713

5.2.2 Allocation of Facilities

As mentioned in Section 4.4, several kinds of water facilities exist in the Study area. In order to evaluate the effectiveness of those existing facilities, the following procedure was adopted in planning and allocation of new water facilities.

Firstly, the existing water sources in use are taken into consideration to be useful for the time being. They are boreholes, dug wells, water holes, charco dams, springs and others (lakes, ponds) on which the villagers depend for domestic water under the current situation. The beneficiary population who rely on these existing water sources is subtracted from the projected target population in the year 2001, 2006 and 2016 respectively.

Secondary, it is proposed to replace such handpumps fitted on the boreholes and dug wells as being out of use by the reason of mechanical troubles. However, the replacement of unused engines and pumps on the boreholes is not proposed because in such cases the water source facilities have troubles with the boreholes themselves as well as observed through the inventory survey of the existing water facilities.

Finally, the construction of borehole(s) is proposed for the villages where available water from the existing water sources is insufficient to cover the target population. If provision of borehole(s) with a handpump (L-1-1 system) is not feasible due to its large population to be served and/or deep water level in the borehole, then alternatives are examined to select suitable one for the village. The alternatives include boreholes with a engine-pump (L-2 system) and solar-pumps (L-1-4 system).

The above process is tabulated in Appendix-3(1)-(4). The overall allocation of facilities are summarised in Table 5.3.

Table 5.3 Summary of Facilities Allocation (New Construction)

Facilities \ District	Target Year	Hanang	Singida Rural	Manyoni	Igunga	Total
Borehole with Handpump (L-1-1 Facility)	2001	45	106	59	54	264
	2006	100	317	147	127	691
	2016	339	1,240	555	372	2,506
	Sub-total	484	1,663	761	553	3,461
Level-2 System	2001	1	4	2	2	9
	2006	-	2	-	-	2
	2016	1	-	-	-	1
	Sub-total	2	6	2	2	12
Solar System (L-1-4 Facility)	2001	-	4	3	-	7
	2006	-	7	4	-	11
	2016	-	17	7	-	24
	Sub-total	-	28	14	-	42
Total	2001	46	114	64	56	280
	2006	100	326	151	127	704
	2016	340	1,257	562	372	2,531
Grand-total		486	1,697	777	555	3,515

As the result of the above procedure regarding allocation of water facilities, it is concluded that several villages have the water facilities with supply capacities enough to meet the estimated future water demand: 59 villages in 2001, 36 villages in 2006 and 15 villages in 2016 as given below:

District	Year-2001 Project	Year-2006 Project	Year-2016 Project
Hanang	6	1	1
Singida Rural	30	18	8
Manyoni	18	14	5
Igunga	5	3	1
Total	59	36	15

In summary, the following 15 villages do not need to construct any water supply facilities by the year 2016 provided that the existing water supply facilities are well maintained.

District		Village
Hanang	:	Dang'aida
Singida Rural	:	Mungano, Samaka, Ujaire, Kipumbuiko
	:	Mkinya, Isseke, Nkuninkana, Mkimbii
Manyoni	:	Muhalala, Hagata, Ngaiti, Kintinku, Londoni
Igunga	:	Itumba

5.3 Facility Plan

5.3.1 Design of Borehole and Well

(1) Borehole

The drilling of boreholes prevailing today in Tanzania is done by the air-hammer (DTH) method. The Study area is covered more or less with soft superficial formation overlying the hard bed-rock formation. In many cases, the borehole sites were selected on a fractured zone which forms an excellent aquifer but is often collapsible. Besides the air-hammer drilling, therefore, the mud-circulating method is quite necessary in order to effectively drill a borehole and increase the successful rate.

The bed-rock portion of most existing boreholes in Tanzania is uncased and opened. In order to extend the life-span of the borehole as well as pump, whole portion of borehole is to be properly cased with casing and screen pipes and packed with selected gravel.

Based on the results of review of existing borehole records, an average depth of project borehole is proposed to be 100 m over the districts, 40 m of soft formation and 60 m of bed-rock formation. The size of permanent casing and screen pipes is to be 100 mm (4 inches) for a handpump borehole and 150 mm (6 inches) for an engine-pump and solar-pump borehole. The proposed designs of borehole are shown in Figure 5.1 (1).

(2) Well

In this Study, new construction of dug well is not planned at the target year of 2001, because present dug wells are assumed to be used till that year. However, lifetime of a dug well is estimated at 5 years, so that reconstruction of dug wells is necessary at the years of 2006, 2011 and 2016. The design of dug well is shown in Figure 5.2.

5.3.2 Pumping Facilities

(1) Handpump

In area where groundwater is readily available at moderate depth, constructing a number of wells installed with handpumps is cheapest means for providing a good water supply. Handpumps are easily maintained by caretakers to be selected from the water user's groups, with

minimum skills, a few simple tools and modest training. The specifications and application of handpump for deep well are as follows:

- Pumping volume per stroke	:	0.32 litre
- Number of stroke	:	40-50 stroke/min
- Pumping volume	:	800-1,000 litre/hr (average 900 litre/hr)
- Pumping efficiency	:	0.8
- Actual pumping volume	:	720 litre/hr (at 30m deep of water level)
- Limit of pumping depth	:	40m
- Operation hour	:	12 hrs/day
- Pumping water per day	:	8,640 litre/day
- Service population	:	430 (at 20 litre/capita/day)
	:	290 (at 30 litre/capita/day)

The typical handpump installation and headworks are shown in Figure 5.3.

(2) Engine-pump

Pumps with a engine will be introduced to the areas where the application of handpumps is not practicable due to deep groundwater table and/or the size of service population of more than 430 persons. A borehole pump (vertical turbine) is recommendable because pumps of this type were installed in many water schemes in and around the Study area. Regarding the prime mover, diesel engines will be used, as electricity is not available in almost all villages.

(3) Wind-pump System

The performance of wind-pump and its possibility of application to the project is examined in this section. In view of the windmill operation, wind-run of 12 km/hr (3.3 m/sec) makes starting operation and wind-run over 32 km/hr (8.9 m/sec) reaching to a full operation. The condition may be converted to daily basis that a wind-run over 150 km/day (1.7 m/sec) is required for the minimum operation and over 300 km/day (3.5 m/sec) is a good wind to gain good performance.

The wind-run records in the Study area are available from three meteorological stations in Singida, Manyoni and Sekenke as stated in Section 3.4.1. In evaluation of wind in view of said windmill operation, the wind-run in Singida shows good record as 220 km/day of the annual daily mean, 380 km/day of the monthly maximum and 108 km/day of the monthly minimum. Despite that many wind-pumps are under operation in the District, the wind-run records in Manyoni are incredibly poor showing 94, 140 and 53 km/day respectively. Those in Sekenke are also poor being 104, 172 and 48 km/day. Both records are deemed to involve some improper components.

Possible application of wind-pump in the Study area is examined through the available daily wind-run records in Singida Airport (January 1987 to December 1988). In consideration of the prevailing condition that the wind-pump would be applied to a borehole of which static water

level is below 40 m, the total head is required to be some 60 m, pumping capacity be as much as possible, the type of windmill and pump of 70 mm size is supposed to be a model which is most popular in the area.

Since the daily wind-run record given as an average wind-speed is not sufficient for the analysis of actual performance of wind-pump, premises are set forth that all daily wind-run was distributed in a pattern of full utilisation, above 12 km/hr and below 32 km/hr. In such an ideal case an output of 400 lit/hr to 1,000 lit/hr may be achieved. For the interval between 12 km/hr and 32 km/hr, an average output of wind-pump is assumed to increase under a proportional constant.

The daily wind-pump outputs in Singida were estimated following the above manner. And, a water balance for a two-year period in the areas was made for the estimate of wind-pump outputs and water consumption by different service population at the supply rate of 20 lcd. Thus, it was clarified that 250 population could be covered through a year by the wind-pump system with a 30 m^3 water tank.

In consideration of said performance, the wind-pump is not applicable in the project since it is neither effective nor reliable as a prime facility for the rural water scheme.

(4) Solar-pump System

A possibility of use of solar-pump (photovoltaic pumping) system is examined in this section in consideration of the experience and available services in Tanzania. The sunshine records in the Study area are available from three meteorological stations in Singida, Manyoni and Sekenke as stated in Section 3.4.1. Averaged annual sunshine hours per day are not so excellent showing 7.7 hr/day in Singida, 7.9 hr/day in Manyoni and 7.1 hr/day in Sekenke.

Taking above records, geographical situation, required water-head (60 to 70m) into account, the photovoltaic factors and expected water amount on the monthly basis are estimated as shown in Table 5.4. The minimum daily pumping rates in Singida and Manyoni are estimated to be 17.0 m^3/day and 19.0 m^3/day (both to take place in December) respectively. Thus, some 900 service population can be covered by this system with 6" borehole, a 30 m^3 water-tank and two domestic points.

Table 5.4 Design Work Sheet of Photovoltaic Pumping System

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q (m^3/day) (11hr)	36.0	29.0	36.0	34.0	38.0	34.0	34.0	29.0	32.0	30.0	30.0	31.0
Q (Singida)	20.0	20.0	25.0	22.0	25.0	27.0	28.0	24.0	25.0	24.0	20.0	17.0
Q (Manyoni)	21.0	21.0	22.0	23.0	25.0	24.0	28.0	24.0	27.0	25.0	23.0	19.0

Notes: Q; expected water quantities in case of 3,520 WP (double 55WP x 32pcs system).

In view of the said performance, the solar-pump is recommendable to be introduced into those villages where any handpump is not applicable due to the static water level of more than 40 m depth and its population size of smaller than the affordability of L-2 system. Six villages meet the above conditions; they are:

Singida Rural District	Manyoni District
(86) Mghamo	(5) Mdunundu
(99) Mangida	(71) Sasajila
(100) Sefunga	(72) Makasuku

A conceptual layout of the system is shown in Figure 5.4.

5.3.3 Design of L-2 System

L-2 system is proposed for the villages which meet the following conditions:

- the service population to be covered by a new facility is more than 4,500 approximately; and
- possible yield of borehole should meet the water requirement for the remaining service population above.

Typical design of the L-2 system is illustrated in Figure 5.5. The parameters for design are as follows:

(1) Total water supply quantity per day

-In case of the population of 4,500

Target year: 2001, 2006: 100,000 lit/day (4,500×20 lcd ÷0.9)

Target year: 2016 : 150,000 lit/day (4,500×30 lcd ÷0.9)

*0.9 = water supply efficiency

(2) Pump operating hour

The pump operating hour per day may be 10 hours maximum. However, the operating hour could be longer than above when the possible yield of borehole is not so enough to meet the demand. The pump operation of 16 hours per day is recommendable in this Study.

(3) Possible yield of borehole

From the conditions of above (a) and (b), the expected yield of borehole is estimated as follows:

Target year: 2001, 2006: 6 m^3/hr (100,000 lit/day ÷16 hr)

Target year: 2016 : 9.5 m^3/hr (150,000 lit/day ÷16 hr)

(4) Selection of Village for L-2 System

In consideration of the possible borehole yield estimated depending on the hydrogeological condition of villages, the L-2 system will be adopted to 14 villages shown in Table 5.5.

Table 5.5 Villages adopted with L-2 System

District	Village (No.)	Possible Yield (m^3/hr)	Service Population	Target Year	Target Population
Hanang	Garawja (6)	6.0	4,320	2001	5,236
	Masakta (30)	12.5	6,000	2016	5,091
Singida Rural	Mang'onyi (16)	7.0	5,040	2001	4,252
	Mwau (18)	6.0	4,320	2001	4,385
	Madamigha (73)	7.0	5,040	2001	5,359
	Itaja (111)	6.0	4,320	2001	4,326
	Ihanja (20)	7.5	5,040	2006	4,591
	Ngimu (109)	6.0	4,320	2006	4,344
Manyoni	Kipondoda (2)	7.0	5,040	2001	5,176
	Itigi Mjini (16)	7.0	5,040	2001	5,252
Igunga	Chomachankol(8)	6.0	4,320	2001	4,893
	Ndembezi (14)	6.0	4,320	2001	4,614
Average		7.0	4,760	-	4,793

Notes: Another two villages of Tupendane and Murama are included in Mang'onyi villages and Madamigha village respectively under the existing water supply systems.

(5) Pump capacity

The average service population and water supply capacity of a L-2 system are designed to be 4,700 persons and 94 m^3/day respectively. Accordingly the pump capacity is around 6,000 lit/hour or 100 lit/min. with the operation of 16 hours a day.

(6) Reservoir tank and Public tap

The design capacity of a reservoir tank is 90 m^3, which is equivalent to almost the total daily water requirement, so as to provide allowance for the maintenance of pumping facilities. The service population of a public tap of double faucets is 470 persons. Therefore, at least 10 public taps need to be installed in order to cover the service population of 4,700 persons. Public taps will be distributed at a density of one tap per sq. km.

5.3.4 Design of Charco Dam

(1) Type of Charco Dam

According to the inventory surveys, some 652,000 livestock units are being raised in the Study area. Some 186 charco dams were constructed in the area to secure water for both domestic and livestock uses. In the Study, the livestock water is to be supplied with storage dams as the water from boreholes is supplied only to domestic use due to the limited water yield of boreholes.

The charco dams may be classified into two types; one is a valley dam type which is located at valley bottom; the other is a dig-down dam type which is located at flat slopes. The characteristics of both types of dams are compared below:

Items	Valley Dam		Dig-down Dam	
1. Structure	Simple	O	Slightly complicated	X
2. Storage Area	Large	X	Small	O
3. Water Depth	Small	X	Large	O
4. Storage Loss	Large	X	Small	O
5. Water Catchment	Large	O	Small	X
6. Siltation	Large	X	Small	O
7. Water-supply Effect	Low	X	High	O
8. Water Management	Difficult	X	Easy	O
9. Construction Cost	Relatively low	O	Relatively high	X
10. Maintenance	Rather easy	O	Rather complicated	X

Notes: O; Advantage, X; Disadvantage.

A dam of dig-down type seems to be more advantageous than a dam of valley type particularly in terms of the water depth in the reservoir, storage loss, siltation and so forth. The MOW recommends a dig-down type of charco dam for livestock water supply; and this type is proposed to be constructed for livestock water supply purposes.

As the topography of the Study area is generally flat, suitable sites for a valley dam is very limited. In Tanzania a charco dam is recommended where the population is well scattered and a large number of small water supplies is required. The type of area where charco dams are to be constructed is open, rolling, or flatfish plains where well defined streams and valleys are scarce but the depth of impervious top layer is in considerable extent. The average size of charco dams so far constructed in Tanzania are 6,800 m3 for the water storage capacity and 4.5 m for the water depth.

(2) **Structure**

A reservoir of charco dam is located at the end of stilling chamber bands. Water is introduced to the reservoir through a pipe from the stilling basin, and pumped up with three handpumps to convey the water to cattle trough located downstream of the dam. The typical design of charco dam is as shown in Figure 5.6.

(3) **Livestock Water Supply**

A possibility of livestock water supply is analysed in terms of the size of charco dam and the meteorological conditions in the Study area as follows:

(a) Conditions of analysis

- Duration of analysis is seven months from May to November considering the rainfall condition, and calculation is made on the monthly basis.
- Full water level in April (end of rainy season) and low water level in the middle of November (start of rainy season) are assumed.
- In-flow to the reservoir of rainfall in May and November is not considered for conservative estimate.
- Only an evaporation loss from reservoir surface is considered as the water loss as follows:

  Water loss = evaporation (pan) x reservoir area* x 0.7

  * Reservoir area is calculated using the water depth of previous month.
- Unit water requirement (one livestock unit) is 25 litre/day.
- By applying variable numbers of livestock units, hence variable water requirements, to the equation, water balance analysis was simulated by error and trial till the water storage meet the predetermined condition that the minimum water storage shall take place in mid November.

(b) Results

As a result, one standard charco dam can supply water to the following number of livestock units:

Meteorological station	No. of Livestock Unit
Manyoni	1,040
Sekenke	980
Singida airport	1,000

In planning of the project, it is assumed that one standard charco dam is able to supply water to 1,000 livestock units through the year.

(4) Proposed Number of Charco Dam

Charco dams will be constructed in the villages where there is no charco dam for livestock use. The number of charco dam(s) to be constructed in a village is determined by dividing the total number of livestock units being raised in the village by 1,000 livestock units as estimated above, thus amounting to 463 charco dams in total over the Study area.

One charco dam will be constructed by the year 2001 for all the proposed villages, the second charco dams will be constructed by the year 2006 for such villages as have two or more proposed charco dams, and the remaing proposed charco dams will be constructed by the year 2016. Summary of charco dam allocation is given in Table 5.6.

Table 5.6 Summary of Charco Dam Allocation

District	Year 2001	Year 2006	Year 2016	Total
Hanang	12	21	46	79
Singida Rural	24	48	109	181
Manyoni	17	36	87	140
Igunga	11	22	30	63
Total	64	127	272	463

5.3.5 Facility Rehabilitation Plan

(1) Type of Rehabilitation

Types of rehabilitation works are sorted as follows:

i) Replacement of the equipment for the facilities which are not operated at present due to out of order,

ii) Replacement of the equipment for the facilities which are being operated at present but are necessary to be replaced in near future,

iii) Reconstruction of main facilities due to its lifetime; and

iv) Replacement of the equipment for the new facilities.

(2) Lifetime

The lifetimes of facilities and equipment are as follows:

Item	Lifetime (Year)
Borehole	20
Dug Well	5
Engine/Pump	10
Handpump (Deep well)	7
Handpump(Shallow well)	5
Pipeline	30

(3) Rehabilitation Plan

(a) Replacement of the equipment (Non-operating facilities)

To minimise the scale of new facilities and maximise present water supply capacities are essential target for the establishment of rehabilitation plan of existing non-operation facilities. The rehabilitation of the existing facilities by the year of 2001 is as follows:

Type	Hanang	Singida Rural	Manyoni	Igunga	Total
L-1-1	1	10	6	-	17
L-1-2	13	3	-	-	16
L-1-3	-	-	2	-	2
L-2	-	-	1	-	1
Total	14	13	9	-	36

Notes: L-1-1: Borehole+handpump (deep); L-1-2: Dug well+handpump (shallow)
L-1-3: Dug well+windmill; L-2: Borehole+Pump/Engine+Pipe

(b) Replacement of the Equipment (Operating Facilities)

98 existing water facilities, which are being operated, will be rehabilitated by the year 2001 due to the expected lifetime of the equipment as given below:

Type	Hanang	Singida Rural	Manyoni	Igunga	Total
L-1-1	-	23	11	-	34
L-1-2	1	11	7	4	23
L-1-3	-	4	23	-	27
L-2	-	3	9	2	14
Total	1	41	50	6	98

(c) Reconstruction of Main Facilities

The lifetime of dug wells and shallow well handpumps is five years. In order to maintain the water supply capacities, 119 dug wells will be reconstructed together with replacement of their handpumps as given below:

Type	Hanang	Singida Rural	Manyoni	Igunga	Total
L-1-1	1	33	17	-	51
L-1-2	14	14	7	4	39
L-1-3	-	4	25	-	29
Total	15	51	49	4	119

(d) Rehabilitation of the Equipment (New Facility)

Type	Hanang	Singida Rural	Manyoni	Igunga	Total
L-1-1	190	529	267	235	1,221
L-1-2	-	-	-	-	-
L-1-3	-	-	-	-	-
L-1-4	-	11	7	-	18
L-2	1	6	2	2	11
Total	191	546	276	237	1,250

(c) Summary of Facilities to be Rehabilitated and Newly Constructed

As the result of above, the facilities to be rehabilitated and newly constructed by district and by target year are summarised as shown in the Table 5.7.

5.4 Equipment Procurement Plan

One of the causes of current low level of services to be provided by the district water engineer is lack of equipment necessary for the preventive maintenance and repairing of the water facilities. In order to enhance the function of the district water engineer and his staff, the procurement of equipment for use of maintenance and repairing of the water facilities in the Study area is proposed.

Regarding the preventive maintenance and repairing of water facilities, the district water engineers are to charge with provision of technical services for maintenance of boreholes, pumps, engines, pipelines and other engineering structures. The proposed equipment includes pickup trucks for periodical visits to the villages; water quality analysis kits; workshop equipment; handpump repairing tools for local mechanics and others. In consideration of the number of facilities to be managed, two sets of equipment and three trucks are to be allocated to Singida Rural district, one set of equipment and two trucks are to Manyoni district and one set each of equipment and truck is to other two districts.

Thus the proposed number of equipment to be procured are as listed below:

Equipment	Quantity	Remarks
Pickup trucks	7	4WD
Workshop equipment	5	
Water quality kits	5	
Office equipment	4	
Tools	10	For local mechanics

5.5 Sanitary Improvement Plan

5.5.1 Introduction

The proposals for the health sector reform (1994, Ministry of Helth) stipulate that although the policy formation and provision of specific health sector guidelines will continue to be vested in the Ministry of Health, the greater emphasis should now be moved towards the district level, and eventually it should go down to the level of the village where health activities need to be boosted. This move is very encouraging because the village leadership and the village health committees (VHCs) shall be in close range of being served by the district health officers in terms of advice, training of village health workers and traditional birth attendants and support for villagers' sensitisation in regard to hygiene education and environmental sanitation.

The move will also enable the villagers to take responsibility to determine what should be done to improve their sanitary conditions and their overall well-being. The VHCs could have full responsibilities to decide/appoint, from among the villagers, who should be trained to become village health workers. One way to help the villagers to have full say as regards their health and sanitary environment is to prepare educational materials for villagers, for women and for use in primary schools by teachers and pupils.

In the proposed project, a specific effort will be paid for the up-grading of proper hygiene awareness and better habit among individuals, households and community through the education and training programme for users. The effort is to be based on the concept described as follows:

5.5.2 Water and Environmental Sanitation

Water and environmental sanitation (WES) is a concept based on the need to supply safe and clean water for improved hygiene conditions of the beneficiaries, and has proved to be a workable concept in attempts to integrate needs in water for drinking, food preparation, personal hygiene and others as a focus for improved sanitary conditions of the beneficiary communities.

The development efforts in providing clean, safe water have been given strong emphasis. However, past experiences have shown that provision of safe and clean water alone was not sufficient to assist in an improvement of environmental sanitation of household as well as community because the sanitary conditions remained poor and lack of sanitary education

facilitated health problems. Therefore, integration of water and environmental sanitation is a positive approach to effective utilisation of water resources for improved quality of life.

5.5.3 Water, Environmental Sanitation and Health

It is imperative to address the linkage between water, environmental sanitation and health. This can be done in the following manner; to inform individuals, households and the community as a whole on how to enjoy better health through proper water use and environmental sanitation; and to assist individuals, households and the community as a whole to adopt the concept. This approach, therefore, calls for the formation of the VHCs at all the target villages to oversee improved implementation of community initiatives in regard to sanitary improvement. Many of diseases are transmitted through two major ways;

- contamination in water source, during collection and storage of water by hands, fingers fly and others; and
- contamination of food by hands, fingers, fly and others.

5.5.4 Prevention of Water Related Diseases

Prevention of water related diseases is based on;

- proper human excreta disposal;
- proper waste disposal;
- proper collection, transportation and storage of water;
- proper treatment and storage of food; and
- proper hygiene habit of individuals, households and community.

(1) Human Excreta Disposal

One of the most important actions which individual and household can take to prevent the spread of germs is to dispose faeces properly and safely. Diseases that human excreta can spread, mostly by fly, include hookworms, typhoid fever, dysentery, cholera, bilharzia and others. People can swallow these germs if the germs get into water, onto food, on the hands or utensils and surface used for preparing food.

The above listed diseases can be prevented by having latrines and using them. If it is not possible to have latrines, adults and children should defecate away from houses, paths, water supplies and anywhere that children play. After defecating the faeces should be buried. Faeces of babies and young children are also more dangerous than those of adults. Therefore, even small children should be taught how to use latrines.

The traditional pit latrine is to be improved somehow; to be covered with a rigid washable platform, made of wooden or concrete, with steps, hole and lid, in order to prevent the outbreak of flies.

(2) Water Collection and Transportation

Most of households collect their water from dug wells, water holes or ponds. All these water sources are exposed to all sorts of contamination both at the water sources and transportation stage. Water sources management is a community responsibility. Measures to prevent contamination of water during collection and transportation include:

- the source of water should be protected to prevent dirt from getting in. For example wells and water holes should be fenced in;
- water which spills around the source should be drained;
- animals and human being should not share the same sources;
- personal hygiene habit of the user who collect water is very important; they should always use clean hands; and
- clean containers with clean covers should be used.

(3) Water Storage

Most of households do not have any latrine hence human disposal is done in the bush. This situation encourages contamination of water storage and collection utensils. The following measures are essential against contamination:

- water storage facilities should be kept clean and covered with clean covers;
- domestic animals should not have access to these water storage containers; and
- whenever communities draw their water from a well by using buckets, strings or scooping containers, these containers should be kept clean and hanged on a rack near the well.

5.5.5 Sanitation

(1) Personal Sanitation

Several diseases can be prevented by hygienic habits such as washing hands with soap and water after contact with faeces and before handling food. Washing hands with soap and water stops germs from getting into food or mouths. It is essential to wash hands after defecating, before handling food and after cleaning the bottom of a baby or child who has just defecated. Children often put their hands into their mouths. Therefore, it is important to wash a child's hands, especially before giving food.

(2) Domestic Sanitation

(Safe Handling of Food)

People can get sick from eating dirty food. They can protect themselves from diseases by taking these measures:

- washing their hands before they prepare or eat food;

- cover the prepared foods by fly net;
- raw fruits and vegetables should be washed before they are eaten;
- in areas where there is no inspection of meat, the meat should be thoroughly cooked to avoid tapeworm infestation; and
- if a person is sick or has sores on his/her hands, he/she should not be allowed to handle food.

(Utensils)

Utensils should be washed with clean water; be dried with clean cloth or be put on a dish rack to dry in the sun or wind so as to prevent flies from landing on them. In cases of places where the winds are strong, utensils can be put on a dish rack inside the house to dry them.

(Latrine)

A latrine should be provided by each household, and it is used when family members are defecating. Traditional type of pit latrine should be improved somehow; covering pit by a washable and rigid platform, made of wood or concrete, with steps, hole and lid.

(3) Environmental Sanitation

From the findings regarding sanitary conditions in the Study area, there is a need to do the following in order to improve the health conditions of the community:

- areas surrounding houses should be cleaned of grass, bush and rubbish in order to get rid of snakes and rats;
- all rubbish should be burnt in order to decrease the number of flies, cockroaches and other infectious diseases which flourish in dirty areas;
- there should be running drainage furrows in order to cut down accumulation of water around houses which are for mosquito breeding;
- rubbish pits should be constructed at appropriate sites;
- all faeces of domestic animals should be cleared away from houses because young children can be infected when playing with solid that has been contaminated by faeces of domestic animals.

5.5.6 Hygiene Education

(1) Approach to Hygiene Education

In order to improve the sanitary environment, it is substantial to aware the proper knowledge and habit on hygiene amongst all levels of individuals, households and communities. Women, housewives in particular, are major bearer for keeping the sanitary condition in their house, and for upbringing of their children in proper hygiene habit. Children in school age are

appropriate saucer to receive fundamental knowledge and habit of proper hygiene. Those two specific levels among others are to be focus in hygiene and sanitary education. To stimulate attention and comprehension about hygiene education, programmes should be prepared through pre-testing, two-way communication, and the social network approach as follows:

(Pre-testing)

Apart from school pupils, the majority of the population in the Study area are either semi-literate or illiterate. It is therefore important that the messages to them are in their own language and written texts should be minimised. Pre-test of educational materials is important to ensure the intended effect with respect to attention, comprehension, credibility of the source and feasibility of implementation.

(Two-way Communication)

Two-way communication, compared to one-way communication, has a much higher chance of achieving successful communication. In two-way communication the receiver can ask questions, ask for elaboration and the source can ask for confirmation of the message to correct misunderstandings. Mass media campaigns should therefore be supported by interpersonal communication.

(Social Network Approach)

The approaches and strategies in hygiene education should be done using the existing social networks. Here the community has its traditional leaders and ways of communication. These means should be utilised to enable them to communicate in their own way using their own methodologies. Messages could start from their tribal and government leaders and such messages could be disseminated through the traditional leaders to youth groups.

(2) School Environment

The environment of the school is important for the health of the school children. If schools do not have good provision for sanitation, clean water and facilities for hygienic preparation of food, children can not be expected to take seriously the sanitary education they receive in the classroom.

The school environment should be kept clean with bins and pits for storing rubbish. Classroom must be kept clean and dry with adequate lighting and ventilation. Moreover, it is important to ensure that latrines in schools are kept clean.

(3) Education in Primary Schools

The most important task in developing a curriculum is to plan the content to match the level and age of the child as he/she progresses through the school. This involves taking the various stages of development (social/emotional, intellectual and physical) into account. The primary

school is a good place for laying the foundations of hygiene awareness that can be built upon in later schooling.

However, in early primary schooling the child can only grasp simple concepts and ideas. It is only in later stags that a child is able to handle more complex and abstract arguments. Therefore, the spread of contents across the different ages may have to be modified for practical reasons. Since in Tanzania only a few children manage to go on to secondary schools, sanitary education in primary schools must aim to be as comprehensive as possible to prepare the child for future life.

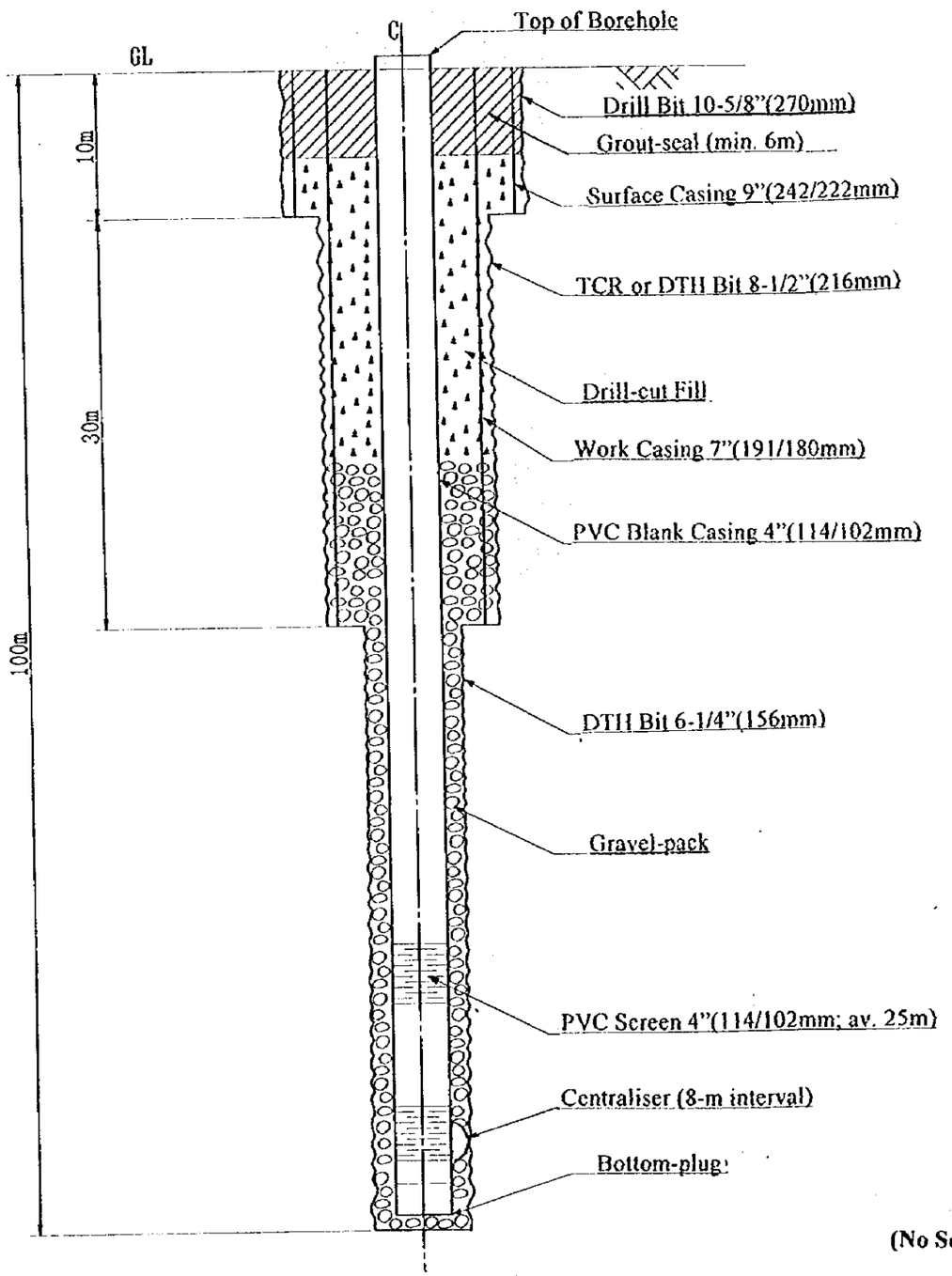
Table 5.7 Bill of Work Quantities by District

No	Cost Item	Unit	Exist. Wel	Year 2001		Year 2006		Year 2016		Year 2001		Year 2006		Year 2016	
			Qty	Rehabli.	Reconst.	Rehabli.	Reconst.	Rehabli.	Reconst.	New Const	Rehabli.	New Const	Rehabli.	New Const	Rehabli.
1	**Hanang District**														
	(1) Level - 1-1 System	place	0	-	-	-	-	-	-	45	-	100	45	339	145
	-ditto- resting	place	1	1	-	1	-	-	1	-	-	-	-	-	-
	(2) Level - 1-2 System	place	1	-	-	-	1×2	-	1	-	-	-	-	-	-
	-ditto- resting	place	13	13	-	-	13×2	-	13	-	-	-	-	-	-
	(3) Level - 1-3 System	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(4) Level - 2 System	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	① Garawja Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	② Masakta Village	place	0	-	-	-	-	-	-	-	-	-	-	1	-
	(5) Charco	place	0	-	-	-	-	-	-	12	-	21	-	46	-
2	**Singida Rural District**														
	(1) Level - 1-1 System	place	23	-	-	23	-	-	23	106		317	106	1,240	423
	-ditto- resting	place	10	10	-	10	-	-	10	-	-	-	-	-	-
	(2) Level - 1-2 System	place	11	-	-	-	11×2	-	11	-	-	-	-	-	-
	-ditto- resting	place	3	3	-	-	3×2	-	3	-	-	-	-	-	-
	(3) Level - 1-3System	place	4	-	-	4	-	-	4	-	-	-	-	-	-
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(4) Level - 1-4 System	place	0	-	-	-	-	-	-	4	-	7	4	17	7
	(5) Level - 2 System	place	3	-	-	3	-	-	-	-	-	-	-	-	-
	① Mang'onyi Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	② Mwau Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	③ Madamigha Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	④ Itaja Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	⑤ Ihanja Village	place	0	-	-	-	-	-	-	-	-	1	-	-	1
	⑥ Ngimu Village	place	0	-	-	-	-	-	-	-	-	1	-	-	1
	(6) Charco	place	0	-	-	-	-	-	-	24	-	48	-	109	-
3	**Manyoni District**														
	(1) Level - 1-1 System	place	11	-	-	11	-	-	11	59	-	149	59	555	208
	-ditto- resting	place	6	6	-	6	-	-	6	-	-	-	-	-	-
	(2) Level - 1-2 System	place	7	-	-	-	7×2	-	7	-	-	-	-	-	-
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(3) Level - 1-3 System	place	23	-	-	23	-	-	23	-	-	-	-	-	-
	-ditto- resting	place	2	2	-	2	-	-	2	-	-	-	-	-	-
	(4) Level - 1-4 System	place	0	-	-	-	-	-	-	3	-	4	3	7	4
	(5) Level - 2 System	place	9	-	-	9	-	-	-	-	-	-	-	-	-
	① Kipoododa Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	② Itigi Mjini Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	③ Manyoni Mjini Village	place	1	1	-	1	-	-	-	-	-	-	-	-	-
	(6) Charco	place	0	-	-	-	-	-	-	17	-	36	-	87	-
4	**Igunga District**														
	(1) Level - 1-1 System	place	0	-	-	-	-	-	-	54	-	127	54	372	181
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(2) Level - 1-2 System	place	4	-	-	-	4×2	-	4	-	-	-	-	-	-
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(3) Level - 1-3 System	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	-ditto- resting	place	0	-	-	-	-	-	-	-	-	-	-	-	-
	(4) Level - 2 System	place	2	-	-	2	-	-	-	-	-	-	-	-	-
	① Chomachankola Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	② Ndembezi Village	place	0	-	-	-	-	-	-	1	-	-	1	-	-
	(5) Charco	place	0	-	-	-	-	-	-	11	-	22	-	30	-
No	Cost Item	Unit	Exist. Wel	Rehabli.	Reconst	Rehabli.	Reconst.	Rehabli.	Reconst.	New Const	Rehabli.	New Const	Rehabli.	New Const	Rehabli.
			Qty	Year 2001		Year 2006		Year 2016		Year 2001		Year 2006		Year 2016	

※ L-1: Borehole+handpump (L-1-1 : deep well, L-1-2 : shallow well)
L-1-3: Borehole+windmill pump+1 D.P.
L-1-4: Borehole+ Sumbersible Pump/Solar Panel+Some D.P.
L-2: Borehole+Pump Engine+Distribution pipe+Some D.P.

Figure 5.1 BOREHOLE DESIGN

(1) TYPE-A (For Handpump Borehole)



(No Scale)

(2) TYPE-B (For Power-pump Borehole)

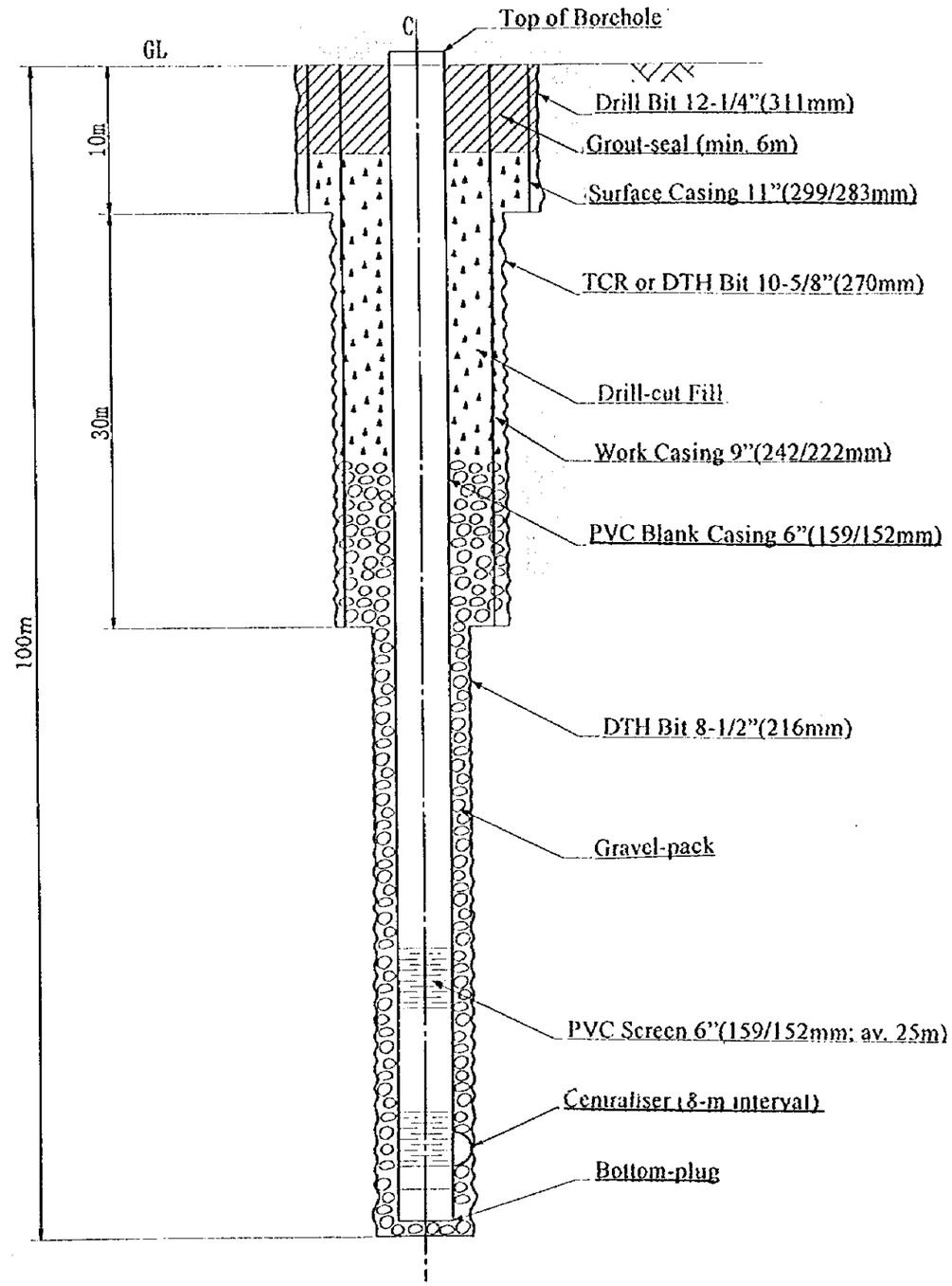
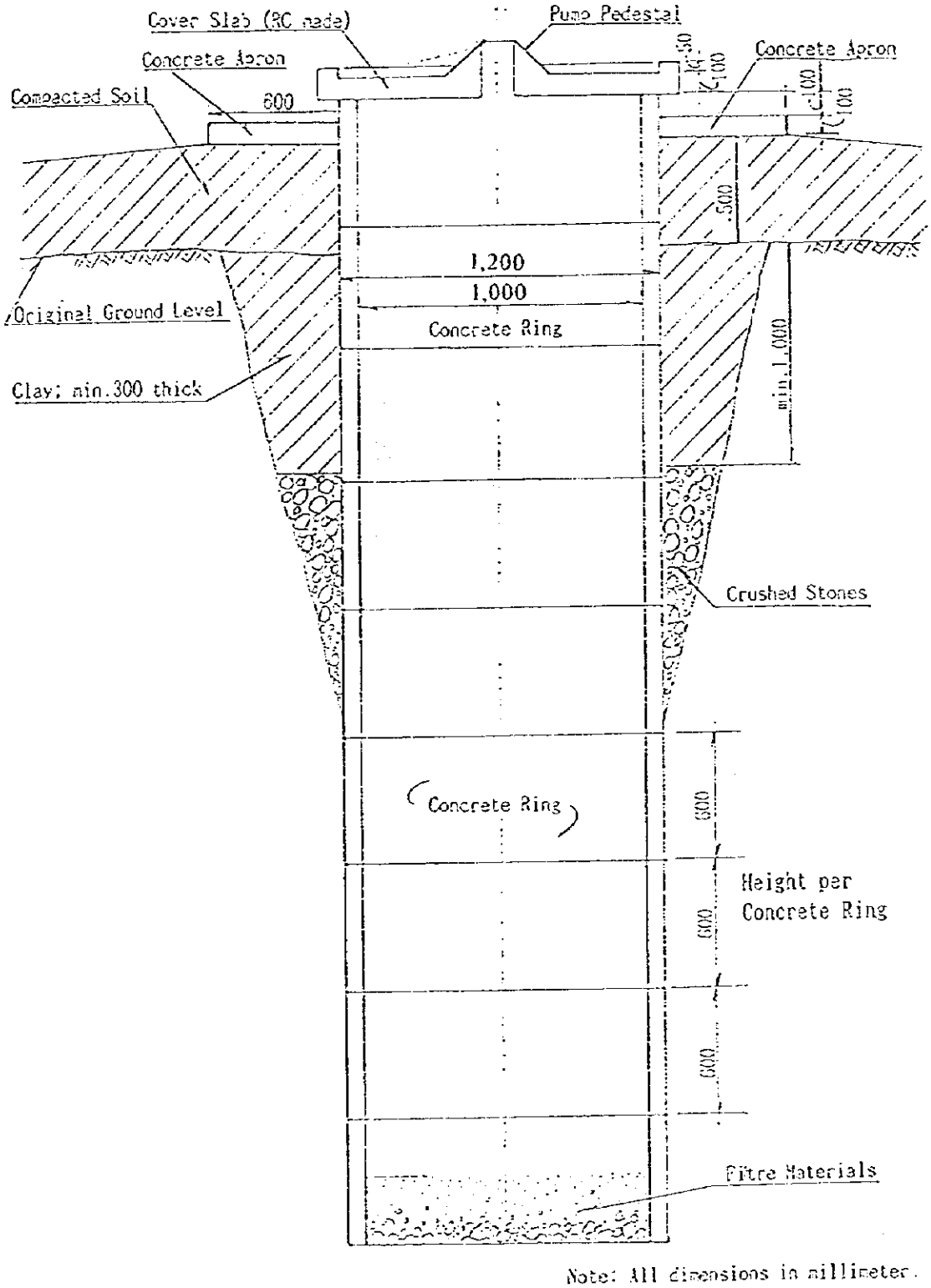
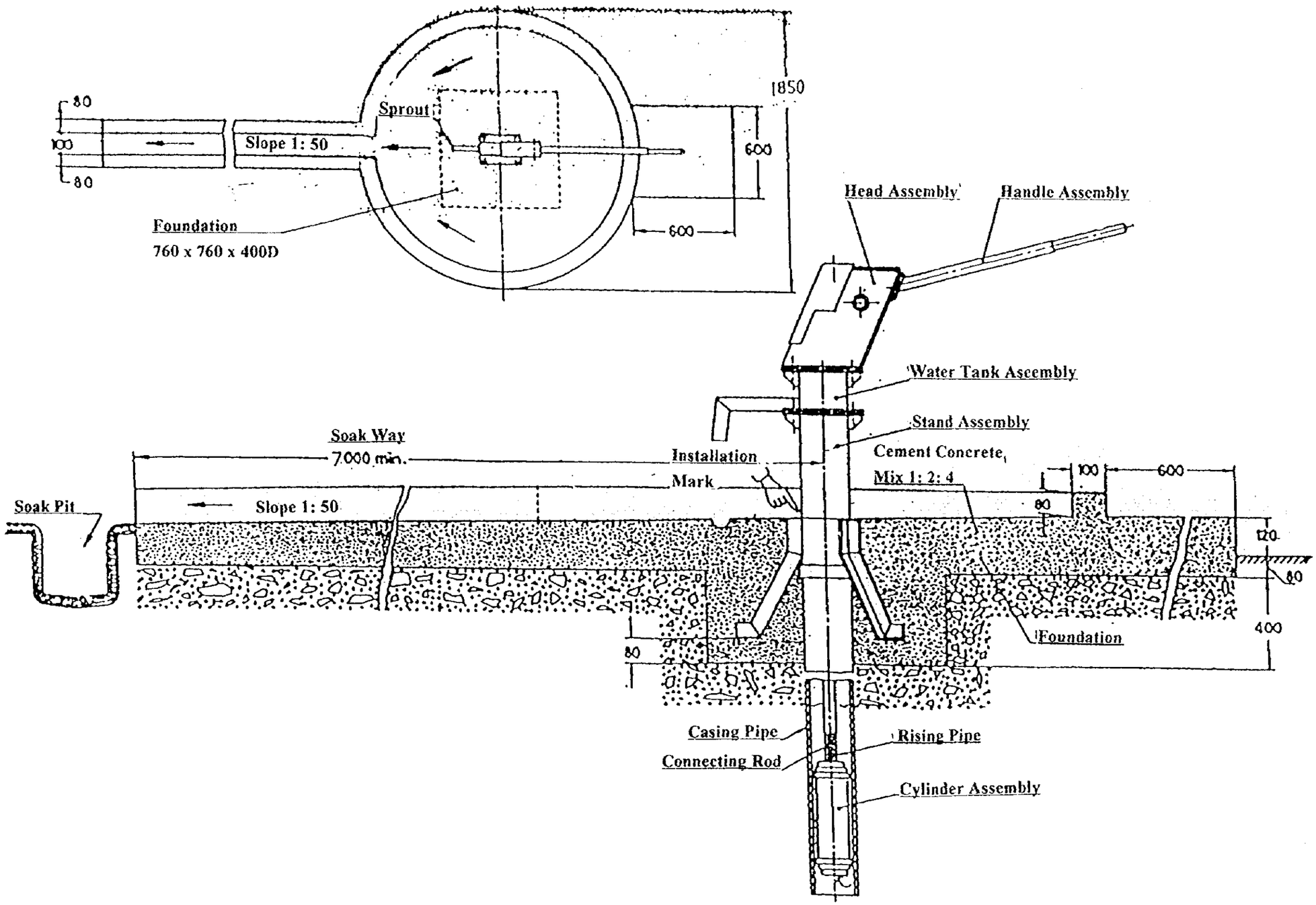


Figure 5.2 DESIGN OF SHALLOW DUG-WELL



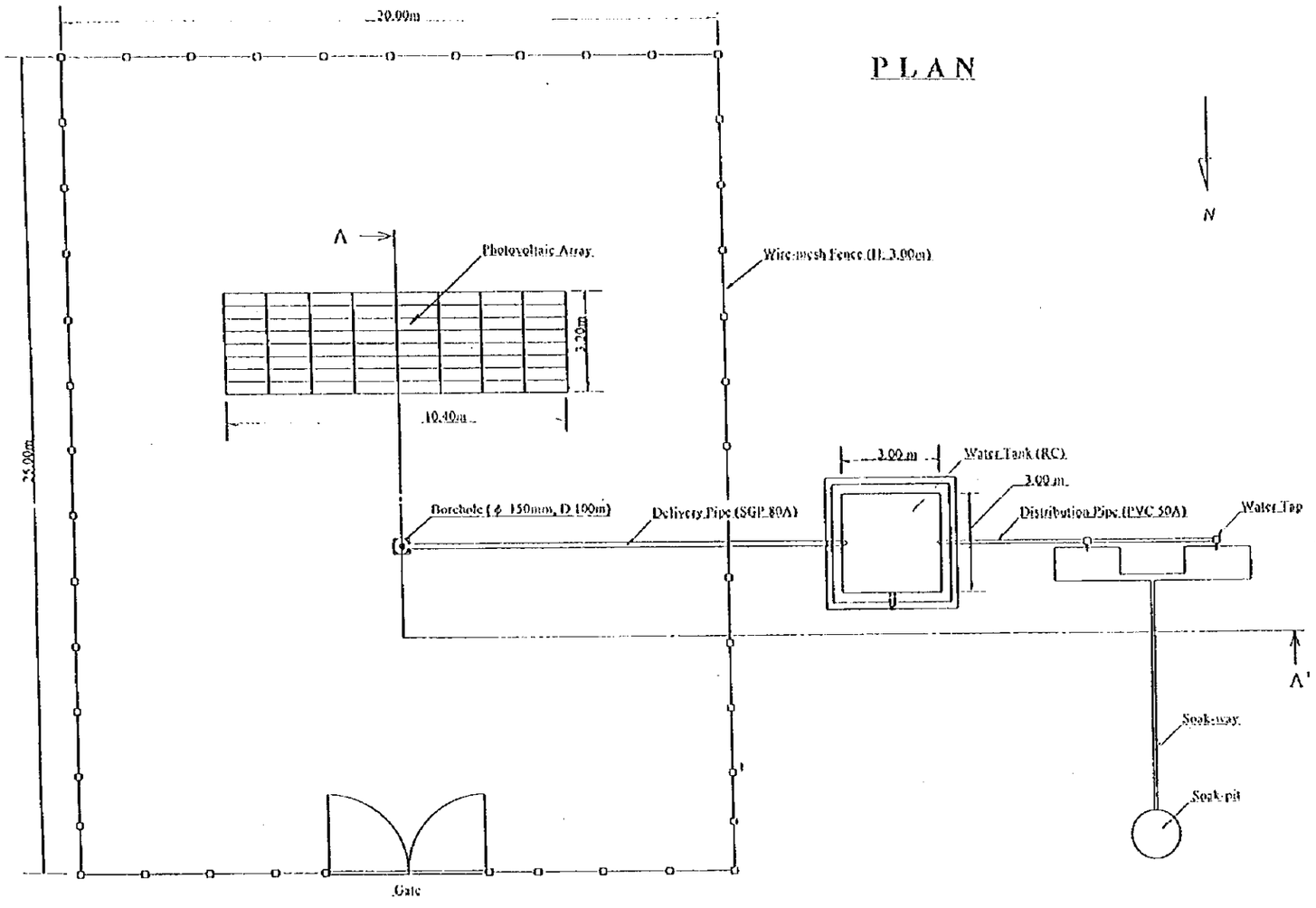
Note: All dimensions in millimeter.



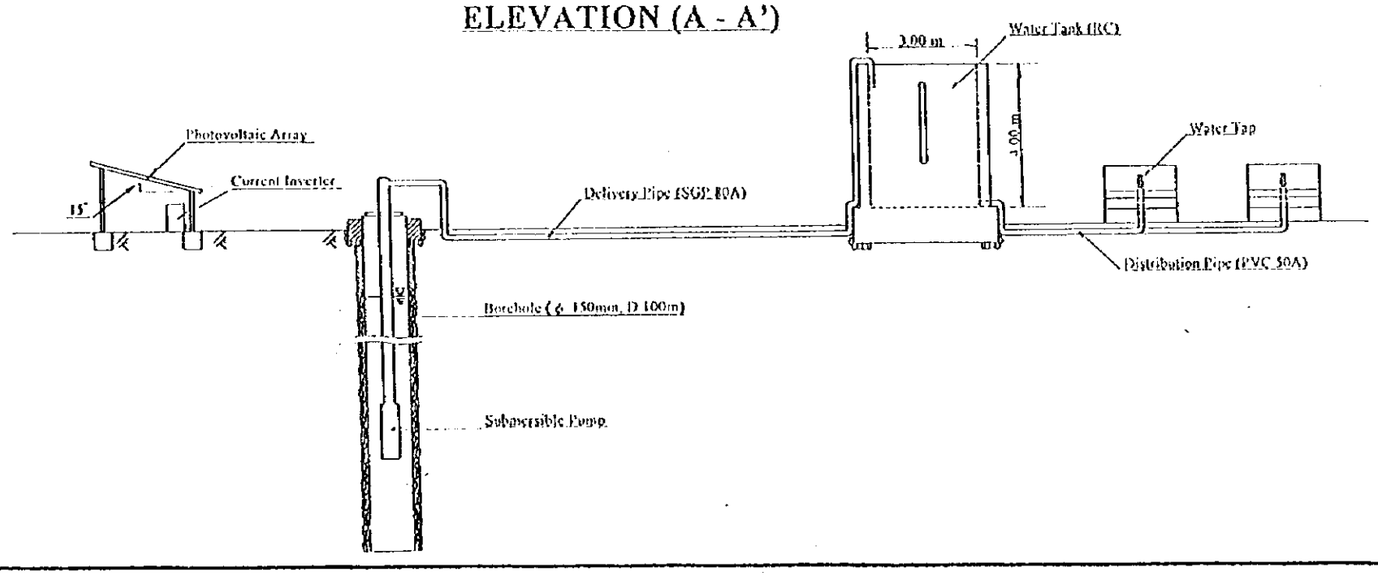
All dimensions in millimetres.

Figure 5.3 DESIGN OF BOREHOLE HEADWORKS

PLAN



ELEVATION (A - A')

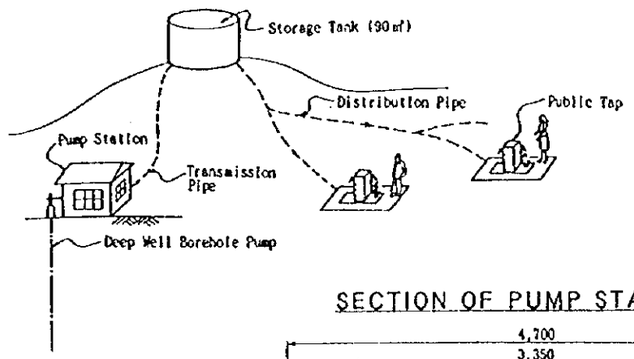


Scale 0 — 5 m

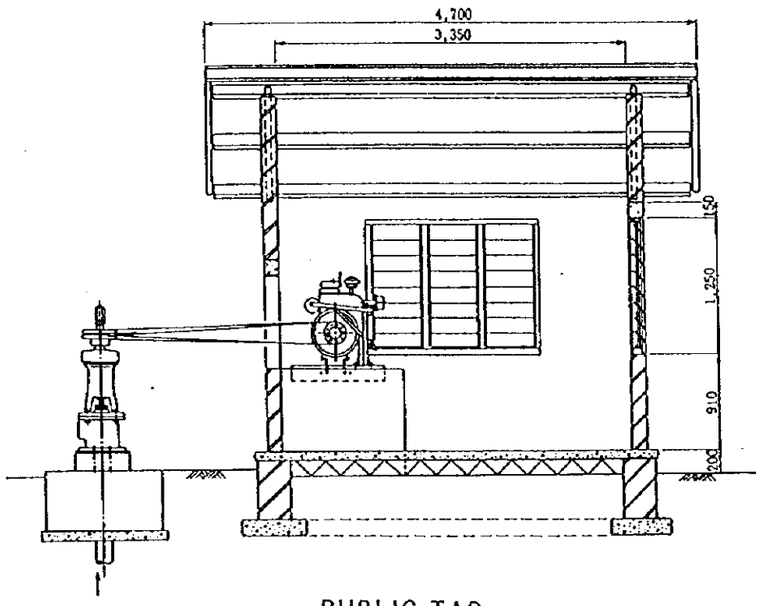
Figure 5.4

JAPAN INTENATIONAL COOPERATION AGENCY (JICA) MINISTRY OF WATER, THE GOVERNMENT OF UNITED REPUBLIC OF TANZANIA			
THE STUDY ON GROUNDWATER DEVELOPMENT IN HANANG, SINGIDA RURAL, MANYONI AND IGUNGA DISTRICTS			
TYPICAL DESIGN OF SOLAR-PUMP SYSTEM (L-1-4 FACILITY)			
DATE	March, 1998	FIGURE NO.	5.3.3
SANYU CONSULTANTS INC. JAPAN ENGINEERING CONSULTANTS CO. LTD.			

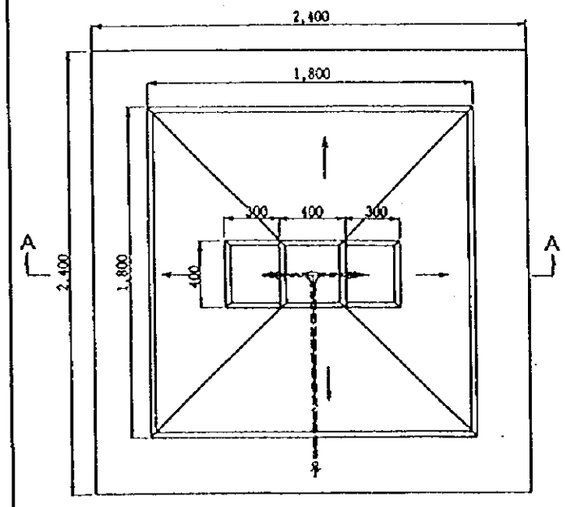
ILLUSTRATION OF THE PLAN



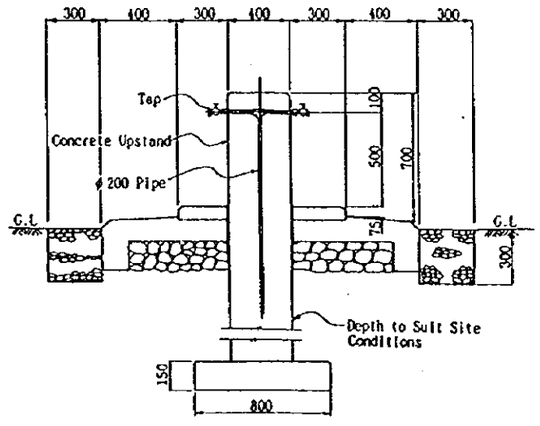
SECTION OF PUMP STATION



PUBLIC TAP

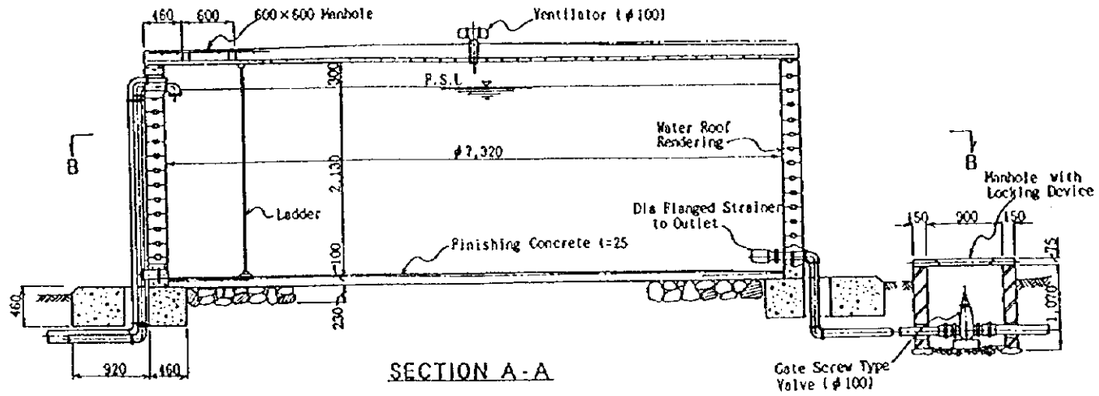


PLAN

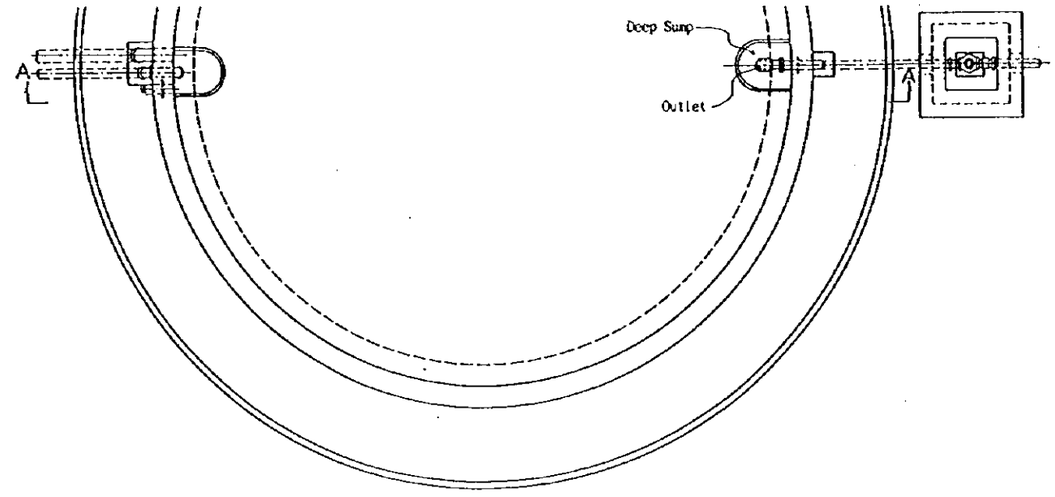


SECTION A-A

STORAGE TANK (90M³)



SECTION A-A

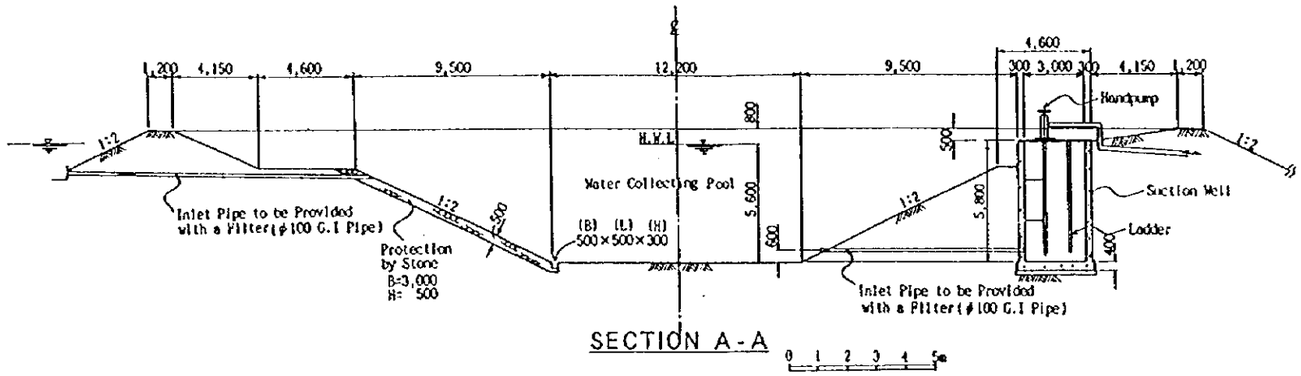


PLAN WITHOUT COVER SLAB
(SECTION B-B)

Figure 5.5

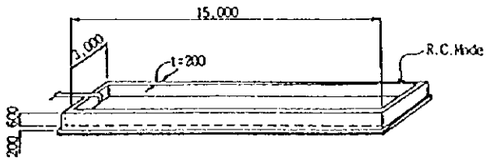
JAPAN INTERNATIONAL COOPERATION AGENCY THE MINISTRY OF WATER THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA			
STUDY ON THE GROUNDWATER DEVELOPMENT FOR IRANGA, SINGIDA RURAL, MANYONI AND IGUNGA DISTRICTS			
TYPICAL DESIGN OF L — 2 SYSTEM			
DATE	Mar. 1988	FIGURE NO.	5.3.4
SANYU CONSULTANTS INC. JAPAN ENGINEERING CONSULTANTS CO.,LTD			



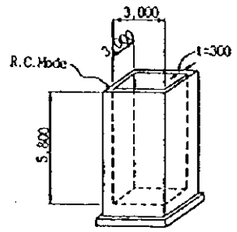



SECTION A-A

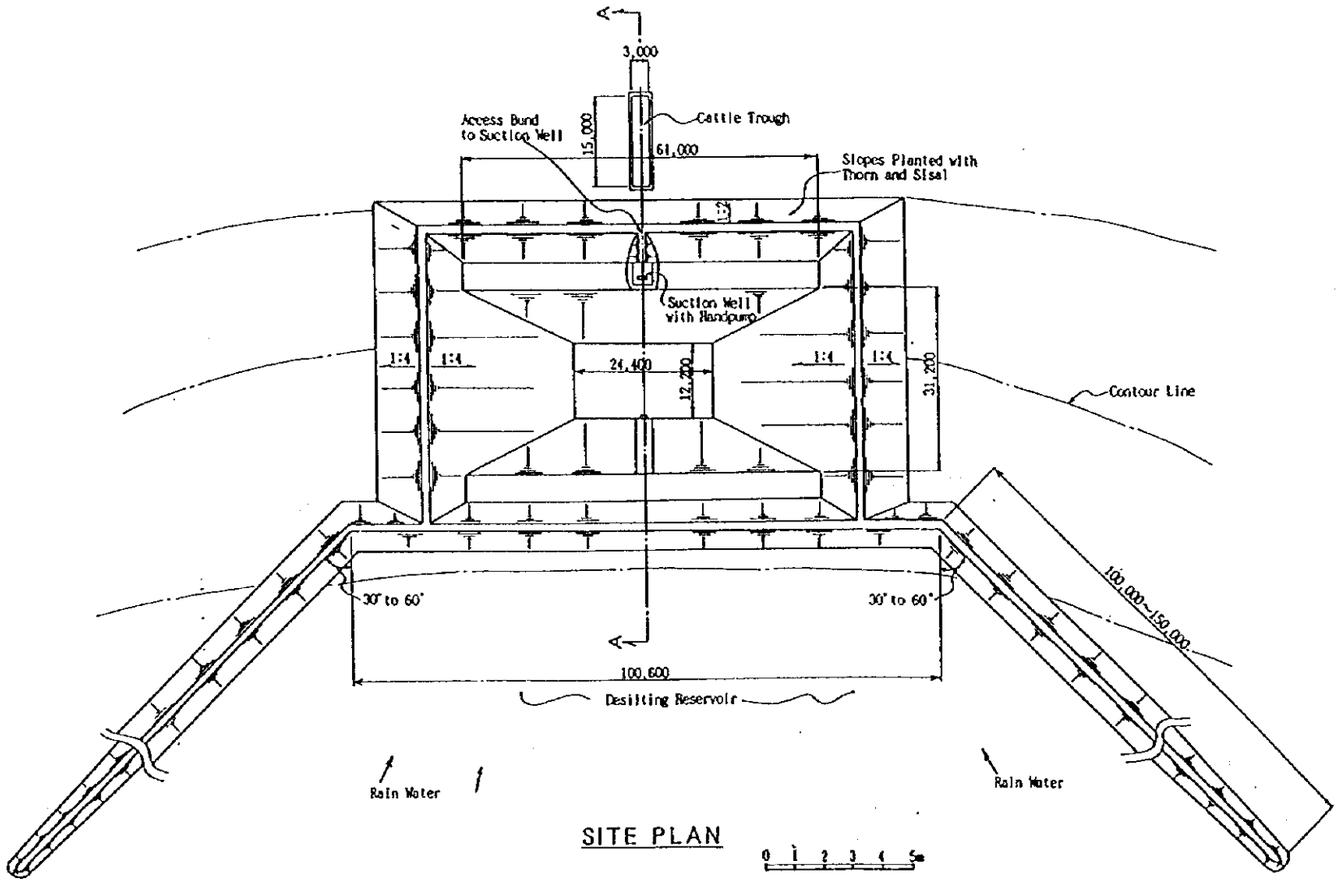
0 1 2 3 4 5m



CATTLE TROUGH



SUCTION WELL



SITE PLAN

0 1 2 3 4 5m

Figure 5.6

JAPAN INTERNATIONAL COOPERATION AGENCY THE MINISTRY OF WATER THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA			
STUDY ON THE GROUNDWATER DEVELOPMENT FOR HANANG, SINGIDA RURAL, MANYONI AND IGUNGA DISTRICTS			
TYPICAL DESIGN OF CHARCO DAM			
DATE	Mar. 1988	FIGURE NO.	5.3.5
SANYU CONSULTANTS INC. JAPAN ENGINEERING CONSULTANTS CO.,LTD			